THE

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THE

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Now in Preparation. New Matter and Corrections should be sent in at once.

H. ALABASTER, GATEHOUSE & CO.,

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THE LAW OF TRADE UNIONS.

As most of our readers are probably aware, an important judgment was delivered in the Long Vacation by Mr. Justice Farwell, when he decided that the Taff Railway Company were entitled to an injunction to restrain the Amalgamated Society of Railway Servants from "watching and besetting." The significance of this decision lay in the fact that the trade union itself was made liable; that responsibility was not attached merely to a treasurer or secretary; and that for the first time in the history of trade disputes, a union was successfully sued in a corporate capacity. Had this judgment been allowed to stand, every union throughout the country would have been compelled to defray the costs of, and pay the damages recovered by, employers in all actions brought to recover compensation for unlawful picketting. The long arm of the law, through the medium of an injunction granted against the union itself, would have been able to reach the members in their private capacity, by making the union liable as a whole. Fully alive to their danger, the delegates at the Trades Union Congress decided to seek, and have now obtained, a reversal of Mr. Justice Farwell's decision, and trades unions are once more enabled to adopt their old tactics.

The discussion in this case, when it reached the Court of Appeal, was purely academical. The strike was over, and the matters in dispute between the parties had long reached a state of quiescence; but the principle involved stretches far beyond the limits of the case which was before the notice of the Court. It amounts to this: Are trades unions entitled to bring to bear upon the settlement of disputes between master and servant all the weight of their corporate authority, their immense influence upon the working classes, and last, but not least, their inexhaustible resources, without fear or restraint? This question the Court of Appeal have been compelled to answer in the affirmative. It may be of interest to discuss a few of the statutes and legal principles which have conferred this immunity upon trades unions.

The three important Acts relating to these bodies were passed in 1871, 1874 and 1876. These Acts legalise the usual trade union contracts, and proceed to establish a registry of trade unions, which gives to each union an exclusive right to the name in which it is registered. They authorise a union to own a limited amount of real and an unlimited amount of personal estate, through the medium of trustees, "for the use and benefit of the members thereof." Officers and treasurers must be provided whose duty it is to make annual returns to the registrar of the assets and liabilities of the society. The misappropriation of the society's funds can be restrained by injunction. In spite of the many indications afforded by the above description, a trade union is neither a corporation nor an individual nor a partner-

ship between a number of individuals; and there is no section in any of the Acts which empowers a trade union to sue or to be sued in its registered name, nor is there any provision which in so many words constitutes it a corporation so that it may be sued as such. Indeed, the presumption is that the Legislature never intended a union to sue or be sued, for by Section 9 of the Act of 1871 it is expressly enacted that the trustees of a trade union registered under the Act or any other officer of the union who may be authorised to do so by the rules, may bring or defend any action in any Court touching the property of the union. But Mr. Justice Farwell argued as follows:—"Although a corporation and an individual or individuals may be the only entities known to the common law who can sue or be sued, it is competent to the Legislature to give to an association of individuals, which is neither a corporation nor a partnership nor an individual, a capacity for owning property and acting by agents; and such capacity, in the absence of express enactment to the contrary, involves the necessary correlative of liability to the extent of such property for the acts and defaults of such agents."

The Court of Appeal, however, has upset this judgment. "Whether this ought to be so or not," said the Master of the Rolls, "is one thing which I have not to inquire into; whether it is so, that is, whether the union can be sued in the manner proposed, is another matter, and this I have to decide. . . . . In my judgment a trade union cannot be sued."

Seeing that the law is thus settled, unless, indeed, the House of Lords over-rule the Court of Appeal, it is interesting to consider the enormous powers which are placed in the hands of the unions. It practically amounts to this, that the Legislature has authorised the creation of numerous bodies of men, capable of owning stupendous wealth, and of employing servants and agents, who may use that wealth, through the medium of their servants and agents, without the slightest responsibility for the wrongs which may be done to third parties. To use the words of Mr. Justice Farwell "They will be at liberty to disseminate libels broadcast, and to hire men to reproduce the rattening methods which disgraced Sheffield 30 years ago, and their victims will have nothing to look to for damages but the pockets of the individuals, usually men of small means who acted as their agents."

It has been said that trades unions are, upon the whole, organs for good, and we feel convinced that the better class of trade associations will hesitate long before they exercise a tithe of the power which has thus been placed in their hands. But instances are not wanting to show that unfair dealing does exist in certain unions, even between members themselves, and cases have arisen in which the union has shown itself only too glad to trade upon the somewhat shadowy nature of its legal obligations. We know of one case in which the rules of a union provided that the money accruing from the subscriptions of members should be applicable in various ways for their benefit. They also purported to regulate the affairs of the trade and provided that any journeyman binding his son in a "foul shop" should be fined and not be entitled to any benefit until the fine was paid. The plaintiff was charged with having broken the rule. He denied it, and refused to pay the fine, and in a subsequent action whereby he sought to participate in the benefits of the union, the Court refused to interfere, on the ground that agreements between members of a union cannot be enforced! Here the union had apparently made no inquiry into the merits of the man's claim; and had sheltered itself behind the fact that the agreement was not binding. If such methods are adopted as between a union and its members, we tremble to think of the means which may be employed when the unfortunate employer comes upon the scene.

What is User of a Patent?

It is a matter of common knowledge that a patent grant confers upon the patentee the sole right to "make, use, exercise, and vend," the patented invention, for a certain period. The meaning of the words "make and vend" is reasonably clear, but what constitutes "user" of an invention? The *primâ facie* meaning of user would seem to be putting it into practice, as for example where a man fits his bicycle with a patent tyre, but the legal interpretation of the term carries us further than this. It seems that any dealing with a patented article comes within the terms "user," so as to render the offending party liable to an action for infringement. The recent case of the British Motor Syndicate *v.* Taylor, furnishes an interesting example. There the defendants had purchased certain articles which were infringements of a patent belonging to the plaintiffs. Not knowing that these articles were infringements the defendants sold some of them to manufacturers in this country and transmitted others to the Continent for sale. In all, 27 infringing articles were disposed of by them. The plaintiffs sued for damages and recovered £8 in respect of each article. Mr. Justice Stirling said: "What the defendants did was to carry these articles out of the United Kingdom with a view to selling them—that is, with the object of turning them to profitable account. By so doing the defendants attained two objects—first, they prevented the operation of the order contained in the judgment where these articles had been declared to be infringements, for the delivery up and destruction of infringing articles; and, secondly, they actually obtained the benefit of the proceeds of sale." Mr. Justice Stirling's decision was confirmed by the Court of Appeal. Relying upon the case of Minter *v.* Williams, which had decided many years ago that mere exposure for sale is not equivalent to sale, the defendants had argued that they were not liable, but the Court of Appeal overruled that case and declared that the defendants should be mulcted in damages. It should be observed that acts of mere passive user are often sufficient to constitute infringement. So, where the defendants had acted as carriers through England of bottles of beer which were sealed with a capsule manufactured in Scotland, which capsule was an infringement of an English patent, they were held liable in damages. But to establish infringement by user, the plaintiff must show that the defendants were using the article for the same purpose which he intended to put it to. In the case of Higgs *v.* Goodwin the patent was for a method of precipitating the animal and vegetable matter in sewage water, so as to make the same applicable to agricultural and other useful purposes. This result was achieved by employing calcium hydrate. The defendants, a Local Board of Health, having first treated the sewage by filtration, deodorized the resulting liquid by adding calcium hydrate. This was held to be no infringement, as the defendants only aimed at purifying their sewage.

Mr. H. Alabaster, 4, Ludgate Hill, E.C.

union is neither a corporation nor an individual nor a partner-

THE WORKS OF LUDW. LOEWE & CO., BERLIN.

(*Concluded from page 790.*)

An analysis is made for sulphur, silicon, and combined carbon every morning from each mixture of the preceding day's cupola melt, and from these analyses are made the slight corrections necessary to keep the mixtures inside limits as we have already more fully detailed.

Daily physical tests of the iron are made as follows:—

Tensile Test.—Test bars 25 mm. round × 250 mm. long are cast in green sand and turned down in the middle to 15 mm. round × 100 mm. long, with a gradually increasing diameter at each end as shown in fig. 12.

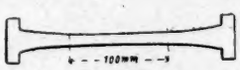


Fig. 12.

The tensile strength of the A and B mixtures runs from 22,500 lbs. to 25,000 lbs. per square inch. The C mixture gives us between 24,000 and 26,000 lbs. per square inch.

Transverse Test.—Made with bars 26 mm. square, with supports 300 mm. apart; load in centre. The A and B mixture gives from 2,100 lbs. to 2,300 lbs. breaking load. The C mixture has a breaking load between 2,400 and 2,600 lbs. The deflection of A mixture averages 0·10 inch, B 0·09 inch and C 0·08 inch.

Contraction Test.—The 26 × 26 mm. bars used for transverse test are cast in the shape of an iron frame exactly 333·33 mm. long, and these bars measured for contraction by means of a wedge scale as per fig. 13.

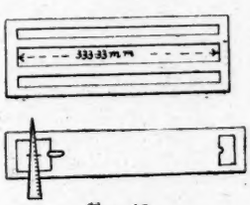


Fig. 13.

The average contraction of the different mixtures runs as follows:—

Mixture A runs from 0·8% to 0·9%	The desired contraction is 0·8%
„ B „ „ 0·9% to 1·0%	The desired contraction is 0·9%
„ C „ „ 1·0% to 1·1%	The desired contraction is 1·0%

Chill Block.—Chill blocks cast in green sand as per sketch are used in order to measure the tendency possessed by the mixtures to chill (fig. 14).

Fig. 14.

These chill blocks are broken through the thick and wedge-shaped portions and the depth of chill measured. It is found the A iron gives from 0 to 0·5 mm. chill, B iron about 0·5 mm., and C iron averages 1 mm. The A and B irons are not allowed to exceed 0·75 mm. chill, and the C iron must not exceed 1·5 mm. chill.

Shrinkage Test.—This test shows the tendency of the iron to shrink or pipe in cooling. An iron mixture with a tendency to shrink will form a shrink hole at point x on fig. 15. The fluidity of the iron is measured by noting the length of the fluidity strip cast on the shrinkage test.

Machineability Test.—The above three mixtures cover all lines of work very well. If a casting does not fill the conditions when made from one mixture a change is made to a softer or harder mixture. For very heavy castings a mixture containing about 2·00 silicon is employed, other elements remaining the same as in mixture C.

Apparatus for Showing the Relative Hardness of Metals.—The object is to make a diagram that graphically shows the

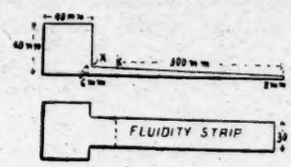


Fig. 15.

relative hardness of two metals at a glance. The apparatus for this purpose can be applied to any light sensitive drill press capable of driving a ½-inch twist drill.

The drill is forced down by means of a weight and cord on a quadrant. On the other end of this segment arm is a small segment which by aid of a cord rotates the drum exactly in proportion as the drill bores into the metal. This drum is held in tension by means of a spring. There is a pencil slide mounted on a bracket, the pencil travelling in a vertical direction exactly in proportion to the number of turns of the drill. Now, if the spindle turned and did not feed, there would be a vertical line, and if the spindle were to feed one inch per turn, there would be a horizontal line.

It is calculated that with soft cast-iron with a given pressure, a feed of 0·0037 inch per revolution of spindle is obtained, and the pencil rises an amount equal to 0·01735 inch. A diagonal line is thus drawn automatically, of which the height represents the number of turns of the drill, and the horizontal distance represents the amount of feed. In using the apparatus the pencil is allowed to travel the full height vertically. This is equal to 161·5 turns; then the horizontal distance is measured and a relative value obtained. A standard drill and standard piece of iron are used, and the ratio calculated for the wear of drill.

On the accompanying diagram, fig. 16, 1 mm. measured on the vertical line is equal to 2·308 revolutions of the spindle. There is always measured off 70 mm. after the drill has penetrated under the surface, 70 × 2·308 = 161·56 revolutions.

4·6 mm. measured on the horizontal line represents 1 mm. depth in test pieces. The standard drill is a flat drill made

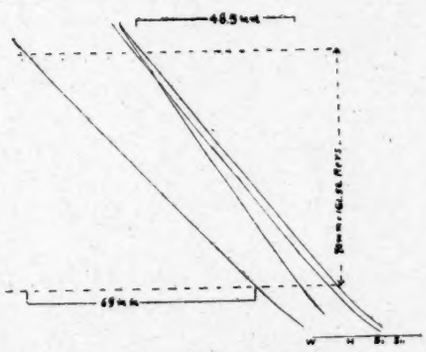


Fig. 16.

from tungsten water-hardening steel and drills a 10 mm. hole.

The standard piece of soft cast-iron is a dry sand casting 2 inches × 1 inch × 40 inches. A number of these bars are all cast from the same iron. This iron when drilled with the standard drill newly sharpened requires 11·46 revolutions to drill 1 mm. deep, equal to 64·6 mm. on the horizontal line. Every time the drill is used to test the hardness of a piece of iron, the standard iron must also be drilled, and the ratio found for wear of drill. For example, if the standard iron gives 56 mm. on horizontal line, then the ratio is

$$\frac{64{\cdot}6}{56} = 1{\cdot}15.$$

fine was paid. The plaintiff was charged with having broken the rule. He denied it, and refused to pay the fine, defendants only aimed at purifying their sewage.

A harder iron gives, say, 48·5 mm. on horizontal line, therefore, $\frac{161{\cdot}56 \times 4{\cdot}6}{48{\cdot}5} = 15{\cdot}32$ revolutions to drill 1 mm. Divide 15·32 by the ratio 1·15, and the result is the number of revolutions required to drill 1 mm. deep compared with the standard iron is equal to 13·32. The soft iron gives 69 mm. on the horizontal line, therefore

$$\frac{161{\cdot}56 \times 4{\cdot}6}{69} = 10{\cdot}77, \text{ and } \frac{10{\cdot}77}{1{\cdot}15} = 9{\cdot}38,$$

the number of revolutions required to drill 1 mm. deep compared with 11·46 for standard iron. The ratio is not allowed to exceed 1·30. The drill is sharpened on a fixture always to the same angle and clearance.

There is thus a clear and determined attempt to find out exactly what an iron will do when cast into machine parts, and where such a system is carried out, with both manufacturing facility in sight and a proper regard to the durability of working surfaces, the result must be good. It is not claimed that these things are yet in full swing, but the intention is there and is in process of being carried out.

There remain to be mentioned a few other items, notably the apprentice school. Free instruction is given in the company's time to all apprentices, and no restrictions are placed on them as to leaving. The subjects taught are mathematics, drawing, elementary mechanics, and chemistry. Attendance is not compulsory, but all without exception do attend. There is also a system of medical attendance, and an accident ward in which, at the time of our visit, one of the workmen had obligingly, but unintentionally, offered himself as an example; we hoped it was not a serious case. The sick and pension system we need not here discuss, because it is based on the German law, and must receive authoritative endorsement, it being, we believe, the German custom to allow such independent provision to be made, subject to authoritative sanction and approval of the details generally.

Our description has already gone beyond the intended length, but we have merely sketched very briefly a few details of these fine works in order to point out to those of our manufacturers and engineers who are still content to proceed along old lines, that competition is being worked along very different lines from formerly. When in the Paris Exhibition recently we saw in the building of a State of Eastern Europe a machine tool that looked well at a distance. On going up to examine it we found that the working parts had actually been polished up with emery cloth. This is not the sort of competition that comes to-day from either America or Germany, and while the general work of neither country is up to the standard of this Berlin shop, the fact remains that this shop exists, and that it is largely an illustration of improved American practice; indeed, it is freely said by Americans to be ahead of anything in America, where the system of manufacture has been so keenly pushed on similar lines. It is a curious fact that the whole of the maple floors came from America, where this wood is plentiful; it is the best wood for floors because it does not splinter up and will even stand things being dragged over it. Most of the tools are American also, and curiously enough are employed to manufacture other tools of stouter proportions to suit European ideas and materials. Our illustrations are sufficient to show the general style and quality of the shop arrangements. We are indebted to Mr. Orcutt, the London representative of the firm of Loewe, for considerable assistance in preparing the foregoing description.

CURRENT SPECIFICATIONS.

XXXVIII.—HENDON ELECTRICITY SUPPLY.

SUMMARY.

Extent of Contract.—Equipment of complete electric lighting system divided into nine sections as follows:—(*a*) Boiler house plant; (*b*) engine house plant; (*c*) condensing plant and pipework; (*d*) overhead travelling crane; (*e*) switchboard and instruments; (*f*) accumulators; (*g*) supply mains; (*h*) meters; (*i*) workshop equipment.

Type and Number of Boilers.—Three to be supplied of Lancashire type, each of 30 feet long by 8 feet diameter.

Output of Boilers.—Each to be capable of evaporating 6,500 lbs. of water per hour when working with natural draught with feed water at a temperature of 60° F.

Working Pressure.—150 lbs. per square inch, but boilers to be suitable for working up to 180 lbs. per square inch.

Superheaters.—Not required.

Mechanical Stokers.—To be of Bennis, Meldrum, Proctor or other approved type worked by an electric motor.

Boiler Feed Pump.—To be of "Weir" single-cylinder direct-acting long stroke or other approved type. Two pumps to be supplied, each capable of feeding the whole of the three boilers above mentioned.

Fuel Economiser.—One 96-tube Green's fuel economiser to be fitted.

System of Working.—Direct current three-wire system with 240 volts between middle wire and either of outers.

Number of Steam Dynamos.—Two, each consisting of one steam engine of 150-KW. output, directly coupled to two dynamos each of 75 KW.

Type of Engine.—Vertical compound, with two or three cranks specified, but any standard type, if in use in equal or larger size for central station work, will be considered.

Specified Speed.—Not to exceed 440 revolutions per minute.

Permissible Variation from Uniform Rotation of Fly-wheel.—½ per cent. per revolution at half load.

Permissible Permanent Variation in speed between No Load and Full Load.—Not to exceed 5 per cent.

Type of Dynamos.—Direct current shunt-wound bipolar machines.

Position of Dynamos.—Both to be placed on same side of engine.

Rating of Dynamos.—To give as normal load 75 KW. at any voltage between 240 and 300 volts, and to work up to 320 volts at increased speed. To give as emergency load for two hours 10 per cent. on above output.

Permissible Temperature Rise.—Not to exceed 60° F. above surrounding atmosphere after 10 hours' full load run.

Steam Consumption Guarantee.—A bonus of £100 will be paid by purchaser for every pound of steam by which the consumption at full load is lower than 28 lbs. per KW.-hour, working condensing with 150 lbs. pressure, and a penalty of £100 per complete pound of steam inflicted upon contractor for every pound of steam by which test exceeds 30 lbs. per KW.-hour.

Output of Motor Transformer.—To receive current on motor side at 480 to 540 volts, and to develop on dynamo side 16 KW. at 160 volts.

Speed of Motor Transformer.—Optional with contractor.

Type of Condensers.—Two of Messrs. Körting's Class B ejector condensers, each condenser to deal with exhaust steam of one engine, and maintain a vacuum of 24 inches.

Type of Circulating Pump.—Two to be supplied of centrifugal type, to be driven by the same electric motor, and each to be capable of lifting 30,000 gallons per hour through a vertical height of 34 feet. The motor is to be suitable for working both at full load at the same time.

Water-Cooler.—A suitable water-cooler of a type to be chosen by contractor, and approved by purchaser, to be supplied.

Type of Crane.—To be of overhead hand-travelling type, suitable for 34 feet span, and for a working load of 10 tons.

Switchboard.—To be arranged as specified, suitable for four dynamos, one motor transformer, six three-wire feeders, and one set of accumulators.

Capacity of Battery.—To be suitable for maintaining a discharge of 80 amperes for 10 hours, without the terminal voltage of the battery falling below 540 volts.

Class of Cable Insulation.—To be of impregnated fibre, paper, or other approved material, lead-covered, and in some cases steel armoured.

System of Laying.—To be in most cases laid solid in earthenware or iron troughing.

Lengths of Cables.—To be of scheduled lengths and sizes.

Type of Meters.—One hundred to be supplied of a type approved by Board of Trade for direct current 240-volt circuits. Meters to be of 5, 10, and 20-ampere sizes as specified.

Specified Dates of Completion.—These are stated in each section, and are generally on basis of completion of work within 10 months of date of awarding contracts.

Penalty for Late Completion.—*One-quarter per cent.* per week during first month, *one-half per cent.* per week during second month *three-quarters per cent.* per week during third month, and *one per cent.* per week during fourth and subsequent months.

Specified Terms of Payment.—On nearly all sections—80 per cent. of value of work executed on site as work progresses, 10 per cent. one month after work has been taken over by purchaser, 10 per cent. nine months later.

Length of Period of Maintenance.—Ten months from date of taking over plant except in the case of cables where period is five years, the cost of maintenance for one year being included in cable price, and for the other four years to be quoted as an extra.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages paid to Workmen.—None.

Amount of Surety Demanded from Contractors.—*Twenty per cent.* of value of contract.

Arbitration Proposals.—Satisfactory.

Date for Receipt of Tenders.—December 31st, 1900.

This specification has been prepared by Mr. Robert Hammond, M.I.C.E., the consulting electrical engineer to the Urban District Council. The work to be done is to be

divided into nine sections, and it is open to any contractor to make offers for any number of complete sections.

The Lancashire boilers are to be fitted with mechanical stokers. Two complete steam dynamos are required, each consisting of a 150-KW. steam engine, having mounted on one side two 75-KW. dynamos. One of these machines is to be placed on either side of the three-wire network, and a margin of capacity is to be allowed in the machines to permit of their being worked at normal output and 25 per cent. higher voltage for cell charging. Only one motor transformer is specified for cell-charging purposes, and as far as possible the auxiliary plant in the station is to be driven electrically by motors of the enclosed or partially enclosed type.

The steam consumption guarantees are severe, and we fear that there is little probability of any bonus being earned by contractors. In the maintenance proposals for cables, the course suggested in the circular recently issued by the Cable Makers' Association has been followed, viz. :— The cost of maintenance for one year is included in the cable price, and for the four succeeding years a separate price is given.

A similar course is adopted with the battery, the stipulation being made that the full specified capacity of the cells must be maintained for the stated sum per annum for a period not exceeding 14 years.

The whole of the specification has been prepared with great care, the requirements are clearly specified, sufficient latitude is allowed in many cases to contractors to permit them to offer standard apparatus, and the exhaustive tests on completion demanded are fully described.

The following are some of the principal features of the general conditions of interest to intending contractors :—

Great stress is laid upon the importance of an early interview after the award of the contract between the consulting engineer to the Council and the duly authorised representative of the contractor in order to settle details, and also agree upon the interpretation of obscure points in the specification.

Clause 15 relating to the supply of extra drawings is fair to both parties.

If claims are made by third parties for damages for patent infringements, the contractor reasonably enough has the right

To conduct all negotiations for the settlement of the same, or any litigations which may arise therefrom.

We have often had reason to complain in these articles of the powers claimed by many engineers to vary the work included in the contract to any degree. Mr. Hammond limits his powers under this head as follows :—

Provided also that, unless *with the consent of the contractor*, the *total sum* of money set out in the contract *shall not be affected* by such alterations, amendments, omissions, or variations *to the extent of more than* 10 *per cent.*

In like manner the power to reject material after inspection as unsuitable for the purpose must be exercised within 14 days of such examination. The clause reads :—

The engineer shall have full liberty, during the manufacture, *to reject all or any materials, plant or workmanship, which in his opinion are not in accordance with the said contract, tender, specification, contract drawings, and these general conditions*, or are defective for any reason whatever, provided that, *if notice of any such rejection be not sent to the contractor within* 14 *days* after the grounds upon which it is based have come to the knowledge of the engineer, *he shall not be entitled to reject* the said materials, plant or workmanship on these grounds. The satisfactoriness or otherwise of the tests at maker's works shall in no way release the contractor from his obligation to make the "tests on completion" stipulated for in Clause 39, or from any other obligations under this contract.

The clause referring to the powers of the engineer to object to any employé of the contractor only asks for his removal, not for his unconditional dismissal from the service of the contractor, a demand often made in municipal contracts. We can recommend the wording to any consultants who may be in doubt as to the fair limits of their powers in this respect :—

The contractor shall constantly employ at least one competent superintendent to superintend the erection of the plant and the carrying out of the works. The said superintendent shall be present on the site during working hours, and shall be prepared to receive from time to time orders and instructions from the engineer or his duly authorised representative. The said superintendent, in the absence of the contractor, shall be considered to be his legal representative.

The said superintendent, if objected to by the engineer, on account of incapacity, misconduct, or negligence, *shall be removed by the contractor, and the contractor shall, within* 48 *hours* after receiving formal objection in writing, *replace him with another superintendent, competent to fulfil his duties.*

The engineer shall be at liberty to object to any person employed by the contractor in the execution of the works who shall, in his opinion, misconduct himself or be incompetent or negligent, and *the contractor must at once remove the person so objected to, and, if necessary, replace him by a satisfactory person.*

All claims made during the progress of the work under the Workmen's Compensation Act, 1897, are to be settled by the contractors for the respective sections. The penalty for late completion is in excess of the maximum amount of *1 per cent. of the contract price per month* suggested in the model clauses drawn up jointly by the Municipal Electrical Association and the Electrical Plant Manufacturers' Association. The clause reads :—

In case the contractor shall fail in the due performance of his contract by and at the times stipulated in the preceding clause, the engineer shall, in writing, certify the fact of such failure, then *the contractor shall pay to the purchasers*, as and for agreed liquidated damages, during the first month of the delay, 5*s. per* £100, *during the second month* 10*s. per* £100, *during the third month*, 15*s. per* £100, *and during the fourth or any subsequent month*, 20*s. per* £100 *of the gross amount of his contract for each and every week* which may have elapsed between the appointed time and the actual time of completion, the said damages to be reckoned only on the cost of such portion of the plant that cannot be used beneficially in consequence of the delay.

The penalties to be enforced in case the plant does not comply with the guarantees are often very loosely expressed, and a great deal of trouble often arises from this cause.

There can be no doubt as to the powers reserved to the purchasers in this case, for it is expressly stipulated that :—

If any portion of the completed plant fails to pass the specified "tests on completion," the engineer may totally reject such portion of the plant, and in the latter event, the purchaser shall have the option of :—

(*a*) Giving the contractor a further period in which to fulfil his contract; or

(*b*) Themselves replacing the defective portion by purchase from or contract with any party or parties.

(*c*) Returning the defective portion of the plant, and recovering the sum or sums paid on account of same.

In the event of (*a*), the plant so supplied shall be deemed to be supplied under the contract, and shall be subject to the terms of the specification, tender, and general conditions.

In the event of (*b*), no further sum beyond that already paid to the contractor in respect of such portion of plant shall be due or payable by the purchaser to the contractor in respect of such defective plant, but the contractor shall repay to the purchasers any sum paid by them in respect of such portion of plant; and the contractor shall also pay to the purchasers any loss or damage to which they may be put by reason of the purchase or replacing of fresh plant by them; the intention being that if the contractor shall fail to supply plant in strict accordance with the specification, it shall be lawful for the purchasers, at their discretion, to obtain, without additional cost to them, the plant from any other party or parties, or to so arrange for the execution of the work as they may deem desirable, and that the contractor shall be liable for any loss suffered by the purchasers in consequence of such failure.

In the event of (*c*), if the defective plant be required by the purchasers for beneficial use, they shall be entitled to make use of the same for a reasonable time sufficient to enable them to obtain other plant to replace it, the contractors being allowed a reasonable sum for the use of the same.

The only other clause to which attention may be directed is that relating to arbitration where it is stated that *no reservations* are made as to the matters which may be referred to the final decision of an independent party. This is as it should be, and in view of the care bestowed upon the preparation of the specification, there is, in our opinion, very little likelihood that there will be need to make use of this provision.

Electric Motor-Cars at the Cycle Shows.—At the Stanley Show the British and Foreign Electrical Company is exhibiting a Creanche electric voiturette, also the Columbia phaeton and the "Powerful" car all fitted with Lecoll accumulators. The last named vehicle took part in the recent Automobile Club trials of electrical cars. At the National Show the Automobile Manufacturing Company show a Cleveland electric Stanhope, while Mr. E. W. Hart, of Luton, exhibits three electrical cars — the "Toujours Contente" (Lohner-Porsche), which took part in the recent trials; a four-seated car fitted with two motors, and a light car for ladies' use, all fitted with Lecoll cells.

THE IMPERIAL PHYSICO-TECHNICAL INSTITUTION IN CHARLOTTENBURG.*

By HENRY S. CARHART.

(*Concluded from page* 814.)

It would not be just to form an estimate of the success of the Reichsanstalt without taking into account its scientific publications. These are numerous, and of great value. Most of the reports of work done are made public, with official sanction, in various scientific and technical journals. During the past year 30 such papers have been published. The detailed accounts, however, of the most important undertakings thus far completed are contained in three quarto volumes of investigations. Among those contained in the first two volumes may be mentioned papers pertaining to thermometry, and to units of electrical resistance.

Four papers of exceptional value relate to normal standards of electrical resistance. They are: the probable value of the ohm according to measurements made up to the present time, the determination of the calibre correction for electrical resistance tubes, the normal mercury standard ohm, and the normal wire standard ohm of the Reichsanstalt. When one recalls that the ohm as a practical unit of measurement is defined in terms of the resistance of a specified column or thread of mercury, it will readily be seen that the work done at Charlottenburg in this particular field is fundamental in character, and of the most universal importance.

In passing, it is worthy of remark that all the standard resistances designed and constructed at the Reichsanstalt are carefully compared with the mercurial standards early in each year. The methods employed in these comparisons, and the forms of the standards, are original with the Reichsanstalt. The new forms and methods admit of a combined accuracy and convenience not previously attained.

In addition to the work done in electrical resistance, the investigation of the silver voltameter, and the electromotive force of standard Clark and Weston cells, has been highly productive of useful results for the other two fundamental electrical measurements. Much remains to be done in this latter direction, for the electromotive force assigned to the Clark and the Weston cell, even in the latest report of the Reichsanstalt, is derived from measurements by the silver voltameter, while the electro-chemical equivalent of silver is in doubt to a greater extent than the electromotive force of the Clark cell.

Perhaps the best indication of the valuable work of the Reichsanstalt is to be found in the annual "Thätigkeitsbericht." This report of the year's activity is published in the "Zeitschrift für Instrumentenkunde," and the reprint for 1899 forms a pamphlet of 25 large, closely-printed pages. The following abstract will convey some impression, though an imperfect one, of the extent of the work accomplished:—

First (Physical) Division.

I. *Work in Heat.*—Determination of the density of water between 0° C. and 40° C.

Determination of the pressure of water vapour at low temperatures.

Determination of the pressure of water vapour near 50° C.

Investigation of thermometers for temperatures between 100° and 200° C.

Investigation of the nitrogen thermometer with a platinum-iridium bulb for very high temperatures.

Investigation of thermometers for low temperatures.

Determination of the thermal and electrical conductivity of pure metals. (These determinations are to be extended down to the temperature of liquid air and up to 1,000° C.)

Investigations with the Fizeau-Abbe dilatometer.

Investigation of the transmission of heat through metal plates.

II. *Work in Electricity.*—Comparison of the normal wire resistances of Divisions I. and II.

Determination of the capacity of an air condenser.

Comparison of the standard cells of Divisions I. and II.

Determination of the conductance of water solutions with a higher degree of accuracy than has been attained hitherto, especially with very dilute solutions.

III. *Work in Light.*—Investigation with electrically-heated black bodies.

Proof of Stefan's law between 90° and 1,700° absolute temperature.

Determination of the relation between the intensity of light and the temperature.

Measurement of radiation in absolute measure.

Determination of the distribution of energy in the spectrum of black bodies.

Determination of the distribution of energy in the spectrum of polished platinum and other substances; also their reflective power.

Second (Technical) Division.

I. *Work of Mechanical Precision.*—Investigation of the errors of length and of the division of 300 scales, tubes, &c.

Coefficient of expansion of 18 bars, tubes, and wires.

Verification of 86 tuning forks for international pitch.

Construction of a new transverse comparator.

Study of the variations of angular velocity of rotating bodies.

II. *Electrical Work.*—Calibration of direct current apparatus, 183 pieces.

Calibration of alternating current apparatus, 58 pieces.

Examination of other electrical apparatus, 76 articles.

Examination of accumulators, primary elements, and switches, 37 articles.

Examination of insulating and conducting materials and carbons, 23 articles.

Installation of storage cells for a current of 10,000 amperes.

Installation of small storage cells for an electric pressure of 20,000 volts.

Installation of alternating current instruments for measuring potential difference up to 500 volts, and current up to 100 amperes.

Examination of 29 samples of alloys for specific resistance and temperature coefficient.

Examination of 126 samples of insulating materials with an electric pressure up to 800 volts.

Verification of single resistances, 123 samples.

Calibration of 33 resistance boxes, compensation apparatus, &c., containing 1,153 single resistances.

Comparison and verification of 133 standard cells—111 Clark and 22 Weston elements.

Determination of the ratio Clark 15° C., to cadmium 20° C., and Clark 0° C. to cadmium 20° C. with a large number of standard cells.

Examination of 21 samples of dry and storage cells.

Calibration of 15 galvanometers to measure high and low temperatures with thermal elements.

Magnetic examination of 25 samples of iron and steel.

Investigation of the difference between the continuous and the discontinuous magnetisation of steel.

Investigation of the influence of repeated heating on the magnetic hardness of iron.

III. *Work Relating to Heat and Measurement of Pressure.*—Calibration of 18,777 thermometers.

Examination of four safety appliances and benzine lamps.

Calibration of 317 thermal elements.

Verification of nine manometers and 22 barometers.

Testing of 190 samples of apparatus for petroleum investigations.

Testing of 3,210 samples of safety rings and plugs.

Testing of 22 samples of indicator springs.

IV. *Work in Light.*—Testing of 149 Hefner lamps for photometric purposes.

Testing of 189 incandescent lamps.

Testing of 143 gas and other lamps and adjunct appliances.

Investigation of the relation between the temperature of sugar solutions and their rotary power on polarised light.

Investigation of quartz plates for the examination of sugars.

Determination of 100 points in the normal Ventzke scale for sodium light.

Especially careful collection of sugars from Germany, Austria, France, Russia, and North America for the investigation of specific rotatory power.

V. *Work in Chemistry.*—Continuation of the study of the solubility of important salts.

Electrolysis of platinic chloride and the migration of the ions.

The quantitative determination of metallic platinum.

Investigation of liquids for use in thermometers to measure low temperatures.

V.—A Lesson for Us.

If Germany has found it to her scientific and industrial advantage to maintain the Reichsanstalt, and is proud of what it accomplishes; and if Great Britain is so impressed with the success of the Institution that she has decided to imitate it, it is surely the part of wisdom for the United States to move in the same direction. Some of the reasons for making this effort one does not need to go far to seek.

In the first place, the scientific interests to be served are certainly as great as in any other country in the world. Original work of a high order is now done in many American Universities; but the difficulties under which University instructors prosecute research are even greater here than in Germany, and we are still compelled to go to Europe for most of our standards. As a result, inventions of an almost purely scientific character originating here have been carried to perfection in the Reichsanstalt, and Germany gets the larger part of the credit. I need only instance the Weston

* Abstract of a paper presented at the 146th meeting of the American Institute of Electrical Engineers, New York, September 26th, 1900. President Hering in the chair.

The best results to be expected from the combination of

curve for the total weight of the car can be drawn from

standard cell, which has been so fully investigated at the Reichsanstalt, and the alloy "manganin," which the same Institution employs for its standard resistances after a searching inquiry into its properties. Both of these are the invention of Mr. Edward Weston, one of the Past-Presidents of this Institute. So long as there is no authoritative bureau in the United States under Federal control, and presided over by men commanding respect and confidence, we must continue "to utilise the far superior standardising facilities of other Governments." The establishment of a national institution for physical and technical purposes cannot fail to foster a vigorous and healthy growth in science, to which we already owe so much of our national prosperity and renown.

In the second place, Congress should be stimulated to take action because of national pride. It is not creditable for a capable and self-reliant nation to continue to depend on foreign countries for its standards of measurement, for the certification of its instruments, and for the calibration of its normal apparatus for precise work. The first day the writer spent at the Reichsanstalt he was consulted with reference to an extended correspondence between the director of the technical division and the officials of the Brooklyn Navy Yard relative to the calibration of a large number of incandescent electric lamps for use in our Navy department. The spectacle of a Government bureau going to a foreign Imperial Institution for standards in an industry whose home is in the United States is a humiliating one. Yet the proceeding was entirely proper and justifiable, because there is in this country no standardising bureau for the purpose desired. Are the representatives of the American people willing to have this state of affairs continue?

Again, the higher interests of the industrial utilisation of scientific knowledge require the establishment in Washington of an institution similar to the Reichsanstalt, and in no degree inferior to it. We are an inventive people, and may justly claim renown in the prompt and efficient utilisation of the discoveries in physical science. It is highly improbable that a practical limit has already been reached in the field of applied physics. We are not estopped from making further discoveries. Still, it may be affirmed with confidence, that the most important and promising work to be done, except in the rare instances in which genius makes a brilliant discovery, will consist in the more perfect adaptation of known physical laws to the production of useful results. It is precisely this field which has not been extensively cultivated, as yet, in the United States. We have explored the surface, and presumably gathered the largest nuggets and the most brilliant gems. To increase the output we must now delve deeper and scrutinise more closely. To drop the metaphor, what will be required for future preeminence is the more intensive and exhaustive study of the scientific conditions in the industrial utilisation of physical laws. This study will require the best talent of our technical schools, aided and supported by an authoritative national institution, itself far removed from patents and commercial gains, but jealous of our national renown and eager to co-operate with manufacturers for the sake of national prosperity.

Germany is rapidly moving toward industrial supremacy in Europe. One of the most potent factors in this notable advance is the perfected alliance between science and commerce existing in Germany. Science has come to be regarded there as a commercial factor. If England is losing her supremacy in manufactures and in commerce, as many claim, it is because of English conservatism and the failure to utilise to the fullest extent the lessons taught by science; while Germany, once the country of dreamers and theorists, has now become eminently practical. Science there no longer seeks court and cloister, but is in open alliance with commerce and industry. This is substantially the view taken by Sir Charles Oppenheimer, British Consul-General at Frankfurt, in a recent review of the status and prospects of the German Empire.

The Reichsanstalt is the top stone of Germany's scientific edifice. It has also contributed much to her industrial renown. The German Government sees with great clearness that the Reichsanstalt justifies the expenditure made for its maintenance, not by the fees received for certifications and calibrations, but by the support it gives to the higher industries requiring the application of the greatest intelligence. In this connection it should be thankfully acknowledged that the services of this imperial establishment are placed at the disposal of foreign institutions of learning with the most generous liberality. The charges for calibration are only about one-fourth the expense incurred in making them, but the support thus given to German makers of instruments of precision, by increasing their foreign orders, is deemed a sufficient return for the services rendered.

THE ELECTRIC MOTOR-CAR PROBLEM.

How to reduce the cost of running electric motor cars to a half or a third of its present amount, is the problem that has to be solved before we can hope that the least objectionable of all the self-propelling vehicles will be economically successful.

Dr. Luxenberg, who discusses this interesting question in the *Centralblatt für Accumulatoren und Elementenkunde*, says the problem can be successfully solved, even with the present means at our disposal. Many have hoped to find the solution in the invention of an accumulator whose weight per unit of energy shall be half that of the present lead accumulator. Hitherto they have hoped in vain, and the invention does not yet appear to be in sight.

Three possible ways have been suggested for improving the mechanical efficiency of electric motor cars. (1) Reduction of the weight of the vehicle by careful construction, use of the best materials, and lightest design. (2) Reduction of the fraction of the resistance to traction due to friction of the axle bearings, by the use of ball bearings. (3) Reduction of the fraction of the resistance to traction due to the rolling friction of the wheels of the vehicle, by increasing the diameter of the wheels.

Dr. Luxenberg estimates the possible reductions of traction resistance that are likely to be obtained by these three methods, and comes to the conclusion that the last method is by far the most hopeful.

Any reduction of weight which is to be effected by the improvement of the construction of the carriage cannot possibly lead to much increase in the efficiency of the electric motor car, because the weight of the carriage is only about 30 to 50 per cent. of the total weight when the carriage is loaded with battery, passengers, and luggage, and the carriages as at present constructed are not capable of much reduction in weight. A two-horse landau, for example, with four places inside and two places on the coachman's seat, weighs empty about 450 kilogrammes (990 lbs.) An electric car of similar capacity weighs about 750 kg. (1,550 lbs.) The excess weight of 300 kg. is chiefly made up of the weight of the motor 100 kg., the gearing 50 kg., the steering apparatus, controller, measuring instruments and other accessories 50 kg.—total 200 kg.; so that there is really only an excess of 100 kg. in the weight of the electric carriage body over that of a similar horse carriage, this being due to the greater strength required for the extra load of batteries, &c. This 100 kg. excess weight is, however, only 5 per cent of. the total weight of the fully loaded car. Dr. Luxenberg is of the opinion that no improvement can result in more than 5 per cent. reduction in the mechanical parts and a corresponding 5 per cent. in the weight of the battery, *i.e.*, 5 per cent. of the weight of the empty carriage, which is only a reduction of 3½ per cent. to 4 per cent. in the total weight of the loaded carriage.

Somewhat better results are to be expected from the reduction of the friction of the bearings by the use of ball bearings. With well constructed bearings with rubbing surfaces the coefficient of friction is 0·1. Thus only 10 per cent. of the weight of the carriage is required to overcome the friction of the bearings; and the greatest possible saving of energy that could result from the use of ball bearings would be about one-tenth of the energy consumed per unit of the total weight of the carriage. The output of the battery would consequently be reduced by one-tenth and this would result in a reduction of about 6 per cent. in the total weight of the loaded car. The total reduction in the consumption of energy would thus be about 16 per cent.

D

This table shows that much larger wheels can be safely used

The best results to be expected from the combination of the first two methods we can see from the above calculations would be a reduction of 4 + 6 = 10 per cent. in the total weight of the car, and a reduction of 4 + 16 = 20 per cent. in the energy consumed. This result, though not to be despised, would not be sufficient to make the electric motor car an economical vehicle. Our only hope, therefore, is in the third method, the increase of the diameter of the wheels of the vehicle.

Rolling friction or resistance is of the nature of a couple, with a constant arm depending on the nature of the rolling surfaces. If α is the angle of an incline which will cause the vehicle to run at a constant speed, f the arm of the couple of rolling resistance, and r the radius of the wheels, then

$$\tan \alpha = \frac{f}{r}. \qquad (1)$$

If T is the resistance to traction, and W the weight of the vehicle, then

$$T\,r = W\,f$$

$$i.e.,\ T = \frac{W\,f}{r}. \qquad (2)$$

The energy, E, consumed in traversing a given length, L, of road is

$$E = T\,L = \frac{W\,f\,L}{r}. \qquad (3)$$

It is evident from these equations that the resistance to traction, and the energy consumed in traversing a given length of track are, *ceteris paribus*, inversely proportional to the diameter of the wheels of the car. The calculation applies strictly to a horizontal track, but in a long run over a hilly country, the up and down gradients will counterbalance each other, if braking is not necessary, and the same may be said of the effect of head and stern winds.

An electric motor car, with wheels 100 cm. in diameter, on a street of medium quality has a resistance to traction amounting to 3 per cent. of the total weight. The energy consumed per ton (French) kilometre in propelling this car will therefore be

$$\frac{3 \times 1{,}000 \times 1{,}000 \times 9{\cdot}8}{100 \times 3{,}600} = 82 \text{ watt-hours.}$$

If this car is driven by a battery of 44 cells, *i.e.*, about 82 volts mean working pressure, and is propelled at a speed of 16 km. per hour (10 miles per hour) over a track 80 km. (50 miles) in length, then a current of 16 amperes for 5 hours will be required. A solid Planté battery of 44 cells of this capacity will weigh about 500 kg., *i.e.*, 50 per cent. of the total weight of the car.

If B is the weight of the battery, it is proportional to E in equation (3); and when the diameter of the wheels are 100 cm., then $B = \frac{1}{2} W$; equation (3) can then be put in the form,

$$\frac{B}{W} = \frac{50}{D}. \qquad (4)$$

If w is the weight of the car without the battery, then

$$\frac{B}{W} = \frac{B}{B + w} = \frac{50}{D},$$

$$B = w \frac{50}{D - 50}. \qquad (5)$$

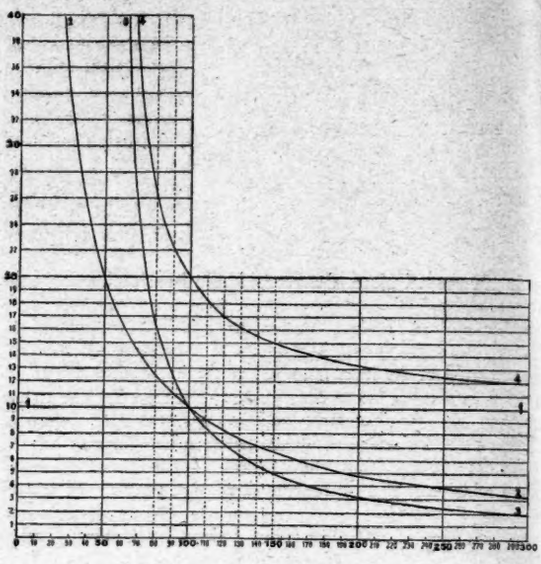
$$W = (B + w) = w \left(\frac{50}{D - 50} + 1 \right),$$

$$= w \frac{D}{D - 50}. \qquad (6)$$

$$\tan \alpha = \frac{300}{D},$$

$$T = W \tan \alpha = w \frac{300}{D - 50}. \qquad (7)$$

Since w is practically independent of the diameter of the wheels D, the only variable factor in the formula for the weight of the battery, and the resistance or the energy consumed per unit length of track is $\frac{1}{D - 50}$; a curve for these three quantities can thus be drawn from this factor. The curve for the total weight of the car can be drawn from equation (6).



Mean diameter of the wheels in cm.

Diagram of an Electric Motor Car (with Planté Battery for 80 k.m.)

Explanation of the Diagram.

No. of the diagram line.	Quantity indicated by diagram line.	Symbol used in text.	Value of the ordinate unit.
1	Total weight minus battery	w	100 kilogrammes
3	Weight of the battery ...	B	,,
4	Total weight of vehicle ...	W	,,
2	Coefficient of resistance ...	$\frac{f}{r} = \tan \alpha$	0·3 in per cent.
2	Energy per ton kilometre	...	8 in watt-hours 0·1 in ampere-hours
3	Resistance of the vehicle...	W tan α	6 in kilogrammes
3	Energy per kilometre ...	...	16 in watt-hours 0·2 in ampere-hours

The question now arises, whether dynamical disadvantages and difficulties of construction are associated with vehicles having wheels so large as 120 or 150 cm. diameter. Constructive difficulties only arise when these diameters have been exceeded, the principal difficulty being in designing the steering gear, so that the load on the steering wheels is not reduced. To prevent a vehicle with high wheels tilting over, the battery must be placed as low as possible. Since there is no room for it between the steering wheels, it must be placed further back; this is objectionable, inasmuch as it reduces the weight on the steering wheels and causes slipping in turning curves on slippery roads. To avoid this disadvantage, the distance between the axles must be increased. As a consequence of this increase the breadth of the wheel track must also be increased to prevent the vehicle turning about the vertical axis passing through the centre of gravity. The distance between the axles should never exceed $\frac{4}{3}$ of track breadth; and since the maximum permissible track breadth is 150 cm., the maximum permissible distance between the axles is 200 cm.

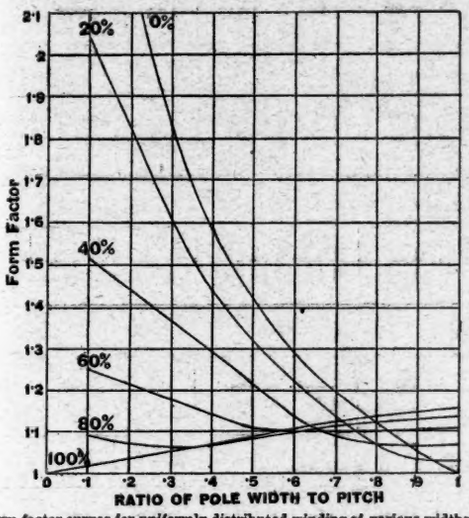
Dr. Luxenberg's experience has shown that the following diameters of wheels can be used without any of the above-mentioned disadvantages:—

Type.	Track.	Distance between axles.	Mean diameter of wheels.
	Cm.	Cm.	Cm.
Two-seat car ...	120	160	110
Four-seat car ...	130	173	120
Six-seat car ...	140	187	150
Omnibus	150	200	180

This table shows that much larger wheels can be safely used in electric motor cars than in horse carriages. The sizes given exceed the usual sizes in electric motor cars by about 40 per cent.: and this, an examination of the diagram will show, results in a saving of 45 per cent. of the energy of propulsion.

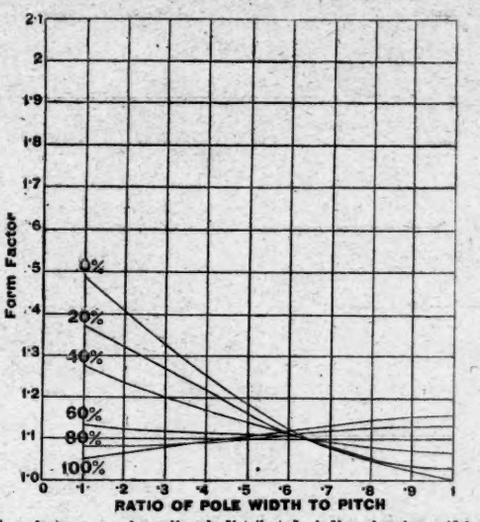
By taking advantage to the utmost of the three methods of improvement discussed above, the energy consumed in an electric motor car can be reduced to $(100 - 20) \times 55 = 45$ per cent. of what is consumed in the present vehicles made after the model of horse carriages. All the wheels of electric cars should be of the same size.

Dr Luxenberg concludes that electric motor cars made with the wheel dimensions given in the above table, to run 50 miles at 10 km. (6 miles) an hour, can be made to compete successfully with horse vehicles. In order to compete with petroleum motor cars, the wheels would require to be 250 cm. to 300 cm. diameter. This would require quite a different design of car from the present, but he does not consider that it is beyond the power of engineering science to solve even this problem.



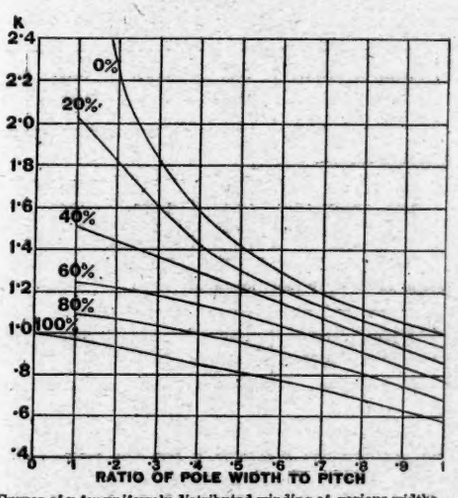
Form factor curves for uniformly distributed winding of various widths without fringe.

FIG. 12.



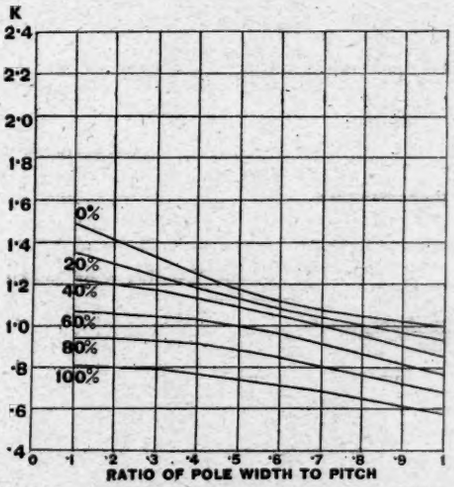
Form factor curves for uniformly distributed winding of various widths with fringe.

FIG. 13.



Curves of K for uniformly distributed winding of various widths without fringe.

FIG. 14.



Curves of K for uniformly distributed winding of various widths with fringe.

FIG. 15.

THE E.M.F. OF ALTERNATORS ON OPEN CIRCUIT.

BY C. C. HAWKINS.

(*Concluded from page* 694.)

THE results which have been tabulated in the preceding article are based on the assumption that the field-system is due to a number of poles of alternate sign. In their practical use it must be borne in mind that they are not applicable to magnet fields of the "inductor" type, although it is only with such fields that large ratios of pole-width, and especially the case of a pole equal in width to the pitch, can be practically realised. In the "inductor" type of field the fringe of lines entering the armature between neighbouring poles of like sign, although not leakage in the proper sense of the word, is not usefully cut by the armature coils; so far from adding anything to the net average or effective E.M.Fs., it always reduces them, since even in the case of a single slot per phase it acts differentially and opposes the main field.

So far we have dealt with the single-phase alternator only, and when there are two or more slots, these have been assumed to be spaced out equally over the whole pitch. The two or more slots of one phase may, however, also be arranged so as to fall within a portion only of the pitch; thus Tables VI.—X. give the figures obtained with and without fringe for two slots separated by a distance of one-sixth or by one-fourth of the pitch—the former results being specially applicable to three-phase, and the latter to two-phase, although both may also be applied to a single-phase alternator. Such cases occupy intermediate positions between the single slot and a winding covering uniformly the same proportion of a smooth armature core. Other arrangements may also be employed, such as three slots in each phase separated by one-ninth of the pitch in three-phase alternators, or by one-sixth of the pitch in two-phase alternators, and as the number of slots per phase is thus increased, the values approximate to those obtained with analogous widths of a smooth winding, which may next be considered.

TABLE VI.—NET AVERAGE E.M.F. WITHOUT FRINGE.

Two slots per pole and per phase.	Ratio of pole-width to pitch.									
	·1	·2	·3	·4	·5	·6	·7	·8	·9	1
One-sixth of pitch apart	·2	·4	·6	·8	1	1·2	1·4	1·6	1·666	1·666
One-fourth „ „	·2	·4	·6	·8	1	1·2	1·4	1·5	1·5	1·5

TABLE VII.—EFFECTIVE E.M.F. WITHOUT FRINGE.

One-sixth of pitch apart	·447	·683	·932	1·125	1·29	1·44	1·57	1·692	1·77	1·82
One-fourth „ „	·447	·632	·836	1·05	1·225	1·38	1·516	1·61	1·672	1·732

TABLE VIII.—FORM FACTOR WITHOUT FRINGE.

One-sixth of pitch apart	2·235	1·71	1·55	1·406	1·29	1·2	1·12	1·058	1·061	1·091
One-fourth „ „	2·235	1·58	1·393	1·31	1·225	1·15	1·08	1·072	1·115	1·155

TABLE IX.—VALUES OF K WITHOUT FRINGE.

One-sixth of pitch apart	2·235	1·71	1·55	1·403	1·29	1·2	1·12	1·058	·983	·91
One-fourth „ „	2·235	1·58	1·393	1·31	1·225	1·15	1·08	1·005	·93	·866

TABLE VIA.—NET AVERAGE E.M.F. WITH FRINGE.

One-sixth of pitch apart	·52	·686	·856	1·02	1·2	1·364	1·504	1·62	1·66	1·666
One-fourth „ „	·517	·68	·842	1	1·178	1·33	1·434	1·465	1·482	1·5

TABLE VIIA.—EFFECTIVE E.M.F. WITH FRINGE.

One-sixth of pitch apart	·685	·884	1·08	1·24	1·384	1·52	1·64	1·73	1·8	1·82
One-fourth „ „	·655	·842	1·04	1·2	1·35	1·48	1·6	1·66	1·704	1·732

TABLE VIIIA.—FORM FACTOR WITH FRINGE.

One-sixth of pitch apart	1·335	1·285	1·26	1·215	1·151	1·115	1·09	1·068	1·085	1·091
One-fourth „ „	1·265	1·238	1·235	1·2	1·148	1·11	1·115	1·13	1·15	1·155

TABLE IXA.—VALUE OF K WITH FRINGE.

One-sixth of pitch apart	1·315	1·26	1·238	1·19	1·13	1·085	1·05	1·005	·966	·91
One-fourth „ „	1·24	1·2	1·193	1·15	1·102	1·058	1·02	·965	·915	·866

TABLE X.—RATIO OF MAXIMUM TO EFFECTIVE E.M.F. WITH FRINGE.

One-sixth of pitch apart	1·84	2·04	1·85	1·61	1·442	1·315	1·22	1·155	1·11	1·1
One-fourth „ „	1·755	1·8	1·815	1·64	1·48	1·35	1·25	1·205	1·174	1·155

II.—SMOOTH-SURFACE ARMATURES.

In armatures with a smooth surface, the winding of each coil is distributed uniformly over a certain portion of the periphery which may be expressed as a fraction of the pitch; a large number of phases differing little from each other have therefore to be compounded, in contrast to the slotted armature, in which, with its grouped winding, a small number of sharply distinct phases are compounded. The advantages and disadvantages of "uniform" and "grouped" distribution are precisely the same, and the one gradually passes into the other; thus the hypothetical case of a single inductor of zero width yields exactly the same theoretical result as a single closed slot in a toothed armature, and the value of its form factor, K, and ratio of maximum to effective E.M.F. may be obtained from the first lines of Tables III., IV., and V., while similarly the 50 slots of the toothed armature were regarded as practically equivalent to a winding distributed uniformly over the whole surface of a smooth core.

When the fringe is neglected it will be found that the curve of instantaneous E.M.F. with any coil-ratio x, and any pole-ratio y is the same as the curve with the ratios changed to y for the coil and x for the pole. Hence, in Tables XI.—XIII. the horizontal column for any width-ratio of coil is the same as the vertical column for the same ratio of pole. But, when the fringe is taken into account, this no longer holds, since the curve of E.M.F. with, *e.g.*, a coil-ratio of ·5 and a pole ratio of ·1, is not identical with that for a coil-ratio of ·1 and a pole-ratio of ·5.

The E.M.Fs. for any width of coil, or any number of inductors may also be reduced to their corresponding values per inductor so as to be directly comparable with the results for a single inductor. It is then more evident that in the cases without fringe the net average E.M.F. per inductor coincides with that of the single inductor, until the width of the coil exceeds the interpolar gap, and thence gradually diverges more and more as the differential action increases and the E.M.F. is lowered. When the fringe is taken into account, there is always some differential action, and the net average E.M.F. of the coil per inductor is always less than that of the single inductor. But whether the average E.M.Fs. of the coil and single inductor coincide or not, the effective E.M.F. of the former, in proportion to its number of inductors, is invariably less than that of the latter, the ratio of the two for any one width of coil rising as the pole is

increased, but reaching a maximum with a particular width of pole and thence decreasing.*

When the figures for the form factor or for K are plotted as a series of curves in one diagram, as in figs. 12—15, the transition from the concave curve for zero width of coil to the convex curve for a coil as wide as the pitch may be conveniently followed. Thus, when the fringe is neglected, the curves for K are concave so long as the interpolar gap exceeds the width of coil, but when it is less become convex. In the curves with fringe taken into account, the same changes may be traced, but each is transferred to a smaller pole-width. In the curves relating to the ratio of the maximum instantaneous E.M.F. to the effective E.M.F., the points of inflection in the fringeless curves are now rounded off, and again are shifted to smaller pole-widths, while the values for any particular width of coil are in general reduced. Thus, with a coil equal in width to the pole and each equal to half the pitch, the maximum E.M.F. is $1\frac{1}{2}$ times the effective E.M.F. as compared with 1·73 times when the fringe is omitted, and in general it may be said that the E.M.F which the insulation withstands in a smooth armature with normal proportions of coil and pole does not exceed in actual machines some $1\frac{1}{2}$ times the effective E.M.F.

The error in the estimate of K when the influence of the fringe is not calculated has the same characteristics as in the slotted armature. For any particular coil-width, it increases as the pole-ratio is reduced, but as the width of coil is increased the divergence of the curves becomes less and less. Thus while the error in the case of a toothed armature with one slot per pole amounts to nearly 15 per cent. with a normal pole-ratio of ·6, it is reduced in a smooth-surface three-phase alternator in which the coil ratio is ·333, to 10 per cent., and in a two-phase or single-phase alternator with a coil-ratio of ·5, to $7\frac{1}{2}$ per cent.

With reference to the best proportions of coil and pole in single-phase alternators, it is sometimes stated that these are obtained when the coil and pole are of equal width and each is equal to half the pitch, the reason assigned being that differential action is then entirely avoided. There must, as a matter of fact, be some differential action due to the fringe in any actual machine, but even if this be neglected the ground for the adoption of some such proportions hardly seems to be correctly stated. For a given frequency, normal flux-density in the air-gap, length of armature core and pitch, the E.M.F. of the alternator is proportional to $K\,x\,y$, where x is the ratio of the coil and y that of the pole. The weight of armature wire is roughly proportional to x, and the total weight of iron in the field-magnet and armature to y. If differential action not only within the fringe but under the faces of opposing poles is then to be avoided at any price, the width of the coil must not exceed the interpolar gap, and with this limitation $K\,x\,y$ is a maximum when $x = y = ·5$. Differential action is, however, only an exaggerated case of difference of phase, and as this is necessarily admitted in the smooth armature with appreciable width of coil, the effect of increasing x or y or both still further should be considered. If the coil be made equal to the pitch, then with the same percentage loss over the armature the output is increased 40 per cent., the cost of the armature wire alone being doubled and all else remaining unaltered; while if the pole is also made equal to the pitch, the total cost of the machine,

* When the fringe is neglected, then whatever the coil-width, the ratio of the effective E.M.Fs. of the coil per inductor and of the single inductor is always the same for a pole of half the pitch as for a pole equal to the pitch, and the maximum value of the ratio is never reached with a pole less than ·75 of the pitch. Thus with coil-widths of 10, 20, 30 and 40 per cent., the maximum ratio occurs with pole-widths of 91, 85, 80, and 78 per cent. respectively; for greater widths of coil the pole giving the maximum decreases but slightly, the lowest value being 75 per cent. in the case of a coil equal in width to the pitch. With the fringe taken into account, the same principle applies, but the maximum ratio is reached with smaller pole-widths, varying from ·75 in the case of a 10 per cent. coil to ·55 in the case of a 100 per cent. coil.

Table XI.—Form Factor of Uniformly Distributed Winding without Fringe.

Ratio of coil-width to pitch.	Ratio of pole-width to pitch.									
	·1	·2	·3	·4	·5	·6	·7	·8	·9	1
·1	2·58	2·04	1·72	1·512	1·37	1·25	1·165	1·092	1·04	1·018
·2	2·04	1·825	1·61	1·44	1·318	1·22	1·14	1·07	1·038	1·036
·3	1·72	1·61	1·49	1·37	1·265	1·18	1·109	1·062	1·05	1·054
·4	1·512	1·44	1·37	1·295	1·21	1·14	1·09	1·07	1·07	1·071
·5	1·37	1·318	1·265	1·21	1·16	1·11	1·095	1·085	1·086	1·088
·6	1·25	1·22	1·18	1·14	1·11	1·105	1·101	1·1	1·101	1·105
·7	1·165	1·14	1·109	1·09	1·095	1·101	1·109	1·115	1·119	1·121
·8	1·092	1·07	1·062	1·07	1·085	1·1	1·115	1·125	1·133	1·136
·9	1·04	1·038	1·05	1·07	1·086	1·101	1·119	1·133	1·145	1·15
1·0	1·018	1·036	1·054	1·071	1·088	1·105	1·121	1·136	1·15	1·16

Table XII.—Values of K for Uniformly Distributed Winding without Fringe.

·1	2·58	2·04	1·72	1·512	1·37	1·25	1·165	1·092	1·035	·968
·2	2·04	1·825	1·61	1·44	1·318	1·22	1·14	1·07	1·01	·932
·3	1·72	1·61	1·49	1·37	1·265	1·18	1·109	1·04	·975	·897
·4	1·512	1·44	1·37	1·295	1·21	1·14	1·07	1·005	·936	·857
·5	1·37	1·318	1·265	1·21	1·156	1·092	1·032	·965	·895	·82
·6	1·25	1·22	1·18	1·14	1·092	1·045	·985	·916	·85	·775
·7	1·165	1·14	1·109	1·07	1·032	·985	·926	·866	·8	·731
·8	1·092	1·07	1·04	1·005	·965	·916	·866	·81	·75	·682
·9	1·035	1·01	·975	·936	·895	·85	·8	·75	·695	·633
1·0	·968	·932	·897	·857	·82	·775	·731	·682	·633	·578

Table XIII.—Ratio $\frac{\text{Maximum E.M.F.}}{\text{Effective E.M.F.}}$ for Uniformly Distributed Winding without Fringe.

·1	3·88	2·45	1·94	1·65	1·46	1·33	1·225	1·14	1·07	1·032
·2	2·45	2·74	2·065	1·735	1·52	1·365	1·255	1·165	1·1	1·07
·3	1·94	2·065	2·24	1·825	1·58	1·415	1·29	1·2	1·14	1·115
·4	1·65	1·735	1·825	1·93	1·65	1·465	1·333	1·24	1·185	1·165
·5	1·46	1·52	1·58	1·65	1·732	1·522	1·385	1·295	1·24	1·225
·6	1·33	1·365	1·415	1·465	1·522	1·592	1·45	1·362	1·31	1·29
·7	1·225	1·255	1·29	1·333	1·385	1·45	1·54	1·44	1·39	1·366
·8	1·14	1·165	1·2	1·24	1·295	1·362	1·44	1·54	1·48	1·462
·9	1·07	1·1	1·14	1·185	1·24	1·31	1·39	1·48	1·6	1·58
1·0	1·032	1·07	1·115	1·165	1·225	1·29	1·366	1·462	1·58	1·732

TABLE XIa.—FORM FACTOR OF UNIFORMLY DISTRIBUTED WINDING WITH FRINGE.

Ratio of coil-width to pitch.	Ratio of pole-width to pitch.									
	·1	·2	·3	·4	·5	·6	·7	·8	·9	1
·1	1·425	1·365	1·305	1·233	1·17	1·12	1·081	1·052	1·03	1·018
·2	1·375	1·325	1·27	1·22	1·16	1·111	1·082	1·055	1·038	1·036
·3	1·325	1·28	1·24	1·19	1·145	1·11	1·085	1·065	1·053	1·051
·4	1·28	1·235	1·204	1·165	1·14	1·113	1·09	1·085	1·073	1·071
·5	1·208	1·176	1·16	1·14	1·125	1·115	1·106	1·098	1·093	1·088
·6	1·135	1·128	1·122	1·116	1·112	1·108	1·105	1·103	1·103	1·105
·7	1·105	1·103	1·1	1·1	1·102	1·105	1·113	1·119	1·12	1·121
·8	1·082	1·083	1·085	1·09	1·102	1·113	1·12	1·129	1·135	1·136
·9	1·06	1·07	1·078	1·093	1·105	1·117	1·13	1·14	1·145	1·15
1·0	1·052	1·065	1·08	1·095	1·108	1·121	1·136	1·15	1·158	1·16

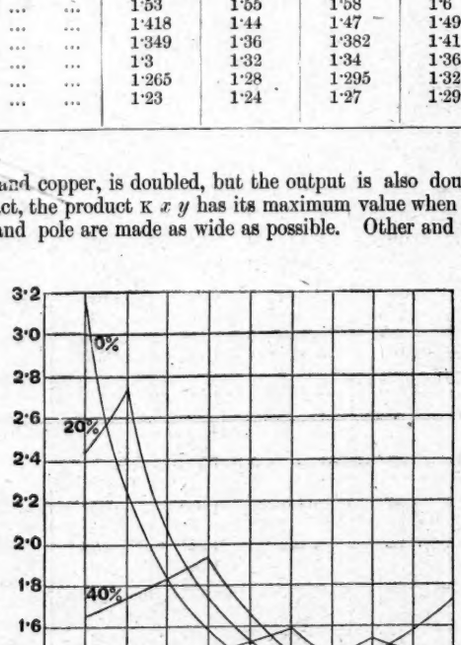
TABLE XIIa.—VALUES OF K FOR UNIFORMLY DISTRIBUTED WINDING WITH FRINGE.

·1	1·415	1·36	1·295	1·225	1·16	1·112	1·06	1·035	1	·968
·2	1·355	1·3	1·25	1·19	1·135	1·09	1·05	1·008	·97	·932
·3	1·295	1·26	1·21	1·162	1·11	1·075	1·025	·983	·94	·897
·4	1·22	1·201	1·17	1·125	1·083	1·05	1	·955	·905	·857
·5	1·15	1·14	1·115	1·09	1·046	1·015	·967	·92	·87	·82
·6	1·075	1·062	1·05	1·03	1	·963	·92	·87	·816	·78
·7	1·015	1·01	·996	·976	·944	·91	·87	·82	·772	·731
·8	·947	·945	·926	·906	·88	·843	·803	·764	·72	·682
·9	·871	·87	·86	·841	·812	·78	·745	·707	·67	·633
1·0	·804	·8	·79	·77	·745	·716	·685	·654	·617	·578

TABLE XIIIa.—RATIO $\frac{\text{Maximum E.M.F.}}{\text{Effective E.M.F.}}$ FOR UNIFORMLY DISTRIBUTED WINDING WITH FRINGE.

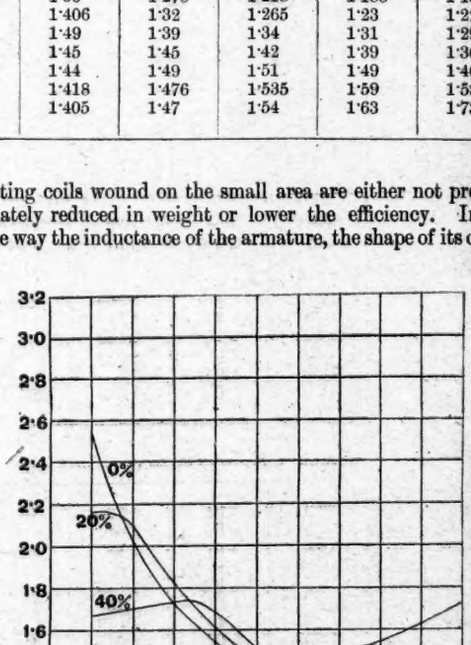
·1	2·49	2·1	1·77	1·57	1·405	1·28	1·2	1·121	1·07	1·034
·2	2·16	2·105	1·835	1·61	1·435	1·31	1·22	1·155	1·104	1·075
·3	1·87	1·88	1·85	1·65	1·468	1·33	1·245	1·182	1·14	1·116
·4	1·67	1·7	1·73	1·68	1·505	1·36	1·278	1·218	1·188	1·168
·5	1·53	1·55	1·58	1·6	1·525	1·406	1·32	1·265	1·23	1·225
·6	1·418	1·44	1·47	1·49	1·499	1·49	1·39	1·34	1·31	1·29
·7	1·349	1·36	1·382	1·41	1·43	1·45	1·45	1·42	1·39	1·366
·8	1·3	1·32	1·34	1·365	1·395	1·44	1·49	1·51	1·49	1·462
·9	1·265	1·28	1·295	1·325	1·36	1·418	1·476	1·535	1·59	1·58
1·0	1·23	1·24	1·27	1·295	1·34	1·405	1·47	1·54	1·63	1·73

iron and copper, is doubled, but the output is also doubled. In fact, the product $\kappa\ x\ y$ has its maximum value when both coil and pole are made as wide as possible. Other and more exciting coils wound on the small area are either not proportionately reduced in weight or lower the efficiency. In the same way the inductance of the armature, the shape of its curve



Ratio $\frac{\text{Maximum E.M.F.}}{\text{Effective E.M.F.}}$ for uniformly distributed winding of various widths without fringe.

FIG. 16.



Ratio $\frac{\text{Maximum E.M.F.}}{\text{Effective E.M.F.}}$ for uniformly distributed winding of various widths with fringe.

FIG. 17.

complicated considerations in reality decide the question. The pole-ratio must not be made too large owing to the excessive leakage that then takes place between the adjacent pole-edges, neither must it be made too small, since the of E.M.F., and its heating, limit the feasible width of the armature coils. Thus the best proportions cannot be determined by any mathematical law, but remain a matter of practical compromise.

AN AUTOMOBILE SHOW IN NEW YORK.

For the first time in the United States (says the New York *Electrical World*) the automobile has had an adequate representation at a popular show, given under the auspices of the Automobile Club of America at Madison Square Garden. The show began on Saturday evening, November 3rd, to which at least eight or ten thousand people flocked. The same excellent attendance was maintained all the week, and "society" also took most kindly to the new "event" in the winter programme. In every respect the show must be declared an emphatic success, most gratifying to the members, nearly all of whom have given their time and services freely to the work of organisation, judging, &c.

Up on the roof, in the space occupied in the summer months by the roof garden, is a huge structure with stiff grade, built for the purpose of showing what hills the automobile can tackle with ease, celerity and safety. This runway is 200 feet long, and at one point 52 feet above the tile floor. It is 8 feet wide, and laid on scantling. It is in four sections, running from 20 per cent. grade up to 43½. At least, that is what is said; the writer has not measured the grades himself. But the spectacle of the tilted vehicle is most impressive and convincing as it negotiates these rapid declivities and stiff hills.

The work of preparation for the show has been chiefly in the hands of a committee, and much credit is due to its members, Messrs. A. R. Shattuck, A. C. Bostwick, C. F. Chamberlain, C. J. Field and S. S. Schwarzkopf, to whose names may be added that of the energetic new secretary, Mr. Malcolm W. Ford. The technical committee, as follows, has also had many duties to perform during the week:—C. J. Field, chairman; Prof. Elihu Thomson, Dr. S. S. Wheeler, T. C. Martin, Alex. Fischer, Prof. R. H. Thurston and Carleton Macy. This committee has also enjoyed the aid of Mr. R. A. Fliess, E.E., and a great deal of excellent work has been done during the week by the new assistant secretary, Mr. F. W. Tousey. Many members of the club have also been active throughout.

One great feature has been the availability and general use of the track. Afternoon and evening it has been full of vehicles moving along usually at the regulation rate of eight miles an hour, but at a suspiciously higher speed whenever the course was a bit clear. When it is stated that some 200 different kinds of vehicles are on hand, and that pretty nearly all of them have been out on the track, some idea of the variety and animation of the spectacle may be formed.

This part of the programme has been varied throughout the week by brake and obstacle contests on the track between the various vehicles in their own classes, and then all types together. Along about 400 feet of the south side of the track in the Garden these tests have been in progress all the week. The braking contests have been determined on speed and distance within which the vehicle can be halted. The interest in that is, of course, chiefly technical, but important to everybody. In the obstacle tests there is some little fun. The obstacles have not been made heavy, so that there is a minimum of risk in colliding with them. Rows of barrels are zigzagged across the track, and the vehicle, having been started by pistol shot, is timed. After negotiating the sharp angles compelled by the first set of barrels, the driver finds himself in a short, narrow lane formed by the wall of the track on one side, and a light rail fence on the other. He steers through this into a "pen" or *cul de sac*, which he can only leave by neatly reversing, unless he wants to knock down one of the three sides. Having backed safely into a clear space to the right, he comes ahead again only to encounter a curving alley of barrels, at the end of which stands the timekeeper. It is evident that here is a chance for some pretty work, as well as opportunity for impressing the public with the great ease with which automobiles can be handled in a crowded street. The scale of the judges is 20 for time, 20 for the barrels, 20 for into the "pen," and 40 for reversing out of it. The vehicle itself has, of course, something to do with success in such a contest, but evidently the best combination is a clever "mobler" with a light machine. It is noticeable that some of those who were clean in their record as to hitting the obstacles, sacrificed their chances of the diploma by taking the route very cautiously and slowly.

The attendance on the last day ran up to some 12,000, and at all times was quite remarkable. There was no hunting for sensations or souvenirs, but a demand for information and prices that all the representatives and salesmen present could not half meet. A great many sales were made during the week, and many more will result directly from the show.

A great feature of popular interest during the week, to the public, consisted in the various trials and competitions on the 20-feet circular track. The finals in the braking and obstacle competitions were both won by an electric automobile against steam and gasoline. The braking contest was won by the Riker Motor Vehicle Company; distances, 14 feet 6½ inches in 6¾ seconds, and 15·11 in 6¾, from speed estimated at over 10 miles an hour. In the obstacle contest the diploma was won by the Baker Electric Company, of Cleveland, in 24¼ and 30¾ seconds.

There was also an interesting little charging plant for electric vehicles on exhibition in the back of the Garden. It had one or two quite useful features. The unit was composed of a 1½-H.P. gasoline motor direct connected to a small shunt-wound generator of 500 watts capacity. The arrangement starts automatically on throwing in the circuit breaker, the generator starting as a motor, its supply of current coming from the battery in the vehicle to be charged. When the gasoline motor reaches speed the relief cock is closed and the dynamo begins to charge the battery. A voltage cut-out is placed on the switchboard which is designed to operate when the batteries have become fully charged. The fuel valve of the gasoline motor is also closed on the opening of the circuit breaker, so that the stopping of the plant is entirely automatic. These units are self-oiling, use either gas or gasoline, and are built for any capacity, and are wound for any voltage.

The demand for a vehicle of greater mileage capacity and a higher rate of speed than normal has been met by the Electric Vehicle Company with its Mark XIX Special. The novel appearance of this automobile is due to the extraordinary amount of battery carried—64 cells, instead of 44, as usual. The mileage capacity on one charge is 85. The controller speeds are 5, 9½, and 17 miles per hour. By operating a foot press, a fourth speed, 23·4 miles per hour, is obtained from the accelerator. The vehicle, while not strikingly æsthetic, has a field of usefulness that is very considerable on account of its wide radius of action, and "looks a thoroughbred."

Of course, there were many vehicles other than those propelled by electric motors on exhibition. In fact, by actual count, there were at one time during the week some 226 vehicles of different makes and design collected under and on the roof of the Garden. Of these 70 were electric, 73 were steam, and 81 were gasoline. It must be understood, however, that even the large number of vehicles noted does not include all those shown at the Garden during the week, for nearly all the exhibitors had a number of vehicles in almost constant operation on the streets of the city, taking out their friends and customers. A number of the exhibitors also added to or changed their exhibits during the course of the week, so that in all probability some 300 or more vehicles were brought to the attention of the patrons of the show at different times.

Some technical notes on the show have been compiled by R. A. Fliess, E.E., from which we learn that there were eight exhibitors in the electric automobile class, aggregating all told some 70 vehicles of many different styles. Of these over 45 are stationary exhibits on the main floor of the Garden, and they illustrate very forcibly to those who remember the automobile and cycle show held under the same roof less than 10 months ago the great expansion that has taken place in this new field of industry in that short time.

To be sure, no very radical improvements can be noticed in running gears, motors, or other mechanical features, nor could any such improvement have been seriously expected, for the reason that the purely mechanical features had already been so far perfected at the time of the last show that only minor improvements in them were necessary. There is, however, a marked improvement noticeable in the general design and finish of vehicles, taken as a whole. The lines of the carriage and wagon bodies in the newer designs are much more graceful and are more satisfying to the eye, while the chopped-off—or where is the horse?—appearance closely associated with some of the earlier styles is in many cases no longer present. The manufacturers, it would seem, are at last beginning to take advantage of the esthetic possibility of the horseless vehicle with good results, and a number of refinements have been incorporated in the latest productions which should add materially to the comfort and luxury of electric automobile locomotion.

A number of new styles have been added to the already long list that has been on the market for the past year. Chief among these is the "piano-box" runabout which has been put on the market by several manufacturers to supply an increasing demand for a light, graceful, and neat electric vehicle, capable of accommodating two persons, and which can be purchased at a moderate and reasonable cost. Many advantages are claimed for the vehicles of this style. Among the more important ones, that of decreased weight for the same passenger carrying capacity would seem to possess the most virtue. The decreased weight, reducing the wear on the tyres, thus lowers appreciably the total charge to the vehicle for an item of expense which in the heavier style of electric vehicle is at the moment very considerable. Decreased weight also makes it possible to use a lighter weight storage battery for practically the same mileage capacity on one charge. This reduces the depreciation and repair charges on the battery, as well as the first cost and renewal charges, each of which is a large item in the heavy styles of electric vehicles. The ability in this style of vehicle to fill the cells of the battery with acid without the necessity of removing them from the vehicle is another advantage claimed, as well as the accessibility of the batteries in case repairs are necessary. It is a style of vehicle that should meet with popular favour at once.

It is quite noticeable that the tendency seems to be more and more toward the use of solid wood wheels and solid rubber tires, especially for all electric vehicles designed for commercial purposes. A very few of the vehicles exhibited are equipped with wire wheels and pneumatic tires. These pneumatic tires are, however, used on the lighter pleasure carriages; but when the weight of these becomes great, solid tires seem to be in order. The one exception noticed to this general tendency is in the heavy hansom cabs and broughams with which New Yorkers are now very familiar. These are fitted out with 4-inch pneumatics.

It is to be regretted that a practice which cannot be too strongly condemned is still in evidence at this show—though, to be sure, to a much less marked degree than formerly. The practice referred to is the very short-sighted one indulged in by some manufacturers of claiming a much greater mileage capacity on one charge of battery for their vehicles than they can accomplish under ordinary circumstances with any reasonable length of battery life. In this way the prospective purchaser is misled and—provided he becomes an owner—is in time disappointed. The dissatisfaction felt by him with his vehicle will soon make itself felt in his neighbourhood and must in time react on the electric vehicle industry as a whole. On the other hand, if the manufacturer would give figures which are within the average mileage radius of action of his vehicle under ordinary circumstances, the purchaser would undoubtedly be much pleased to find some day that he could actually get more distance out of his

vehicle in case of necessity than he had supposed possible, and his pleasure at the discovery would certainly be of benefit to the industry. This tendency, which was at one time very bad, is now much improved, especially among the larger and older firms. The worst transgressors at present are the newer and smaller concerns.

The practice of using an underslung battery in connection with commercial vehicles, such as public cabs, delivery wagons, stages, &c., is gaining ground, and would seem to be a step in the right direction.

In the spider stanhope exhibited by Strong & Rogers, of Cleveland, Ohio, its single motor is placed close to the right-hand rear wheel—not in the centre of the carriage, as in most other makes employing a single motor. The object is to eliminate the weakening effect of the divided shaft, which is necessary when using one motor, which drives through a single gear wheel fastened to the rear axle. A system of bevelled gears are fastened to the right-hand rear hub, which revolves concentrically with, but independent of, the rear axle. This system of bevel gears meshes with a second system connected to the main driving gear, which is keyed to the rear axle, as is the left-hand rear wheel. By this means the solidity of an unbroken rear axle is obtained while driving through the rear axle with a single motor equipment. Several other manufacturers obtain the same end in a slightly different way. The Kensington automobile also has its single motor fastened close to the right-hand side of the rear axle. The object sought is the same as with the Strong & Rogers carriage mentioned above. In the Kensington automobile a double reduction gear is used between the motor and the shaft, which, it is claimed, permits of a more economical motor construction, due to its higher speed.

The General Electric Company exhibits an electric hydrant, which is designed to be used by electric vehicles that are in need of replenishing their batteries. The hydrants are to be placed at convenient points. They operate on the "penny-in-the-slot" machine principle. When a vehicle needs a charge, all the operator has to do is to run up to the hydrant, put a suitable charging plug in one of the four receptacles designed to receive it, and then drop a 25-cent piece in the slot and wait. There are four receptacles, each of which is numbered. No. 1 represents a charging current of 20 amperes, No. 2 a charging current of 30 amperes, No. 3 a charging current of 40 amperes, and No. 4 a charging current of 50 amperes. Provision is made, by means of a push button, by which the charging plug can be taken out of any one receptacle, and placed in any other without cutting off the current supply paid for. The supply is about 2·5 KW.-hours, and when this has been furnished, the current is automatically cut off, and no more can be obtained until another 25-cent piece has been put in the slot.

In connection with this charging hydrant, or "Electrant," as it is called, an interesting point is brought out forcibly. That is, that of the eight makes of electric vehicles exhibited, but three use charging plugs and receptacles that are similar. The other five use specially constructed plugs, each of a different design, and none of which could be used in the receptacles provided in the hydrant. It would seem as though all electric vehicles should have a standard charging plug receptacle fastened somewhere in circuit. This would eliminate the necessity of providing several different styles of charging plugs at the different charging stations as they spring up. To most persons uniformity would seem to be desirable. It is to be hoped that the manufacturers will get together and decide upon one standard form.

Of the eight exhibitors of electric vehicles, the Riker Motor Vehicle Company, of Elizabethport, N.J., had the largest number of vehicles on exhibition on the opening night. This company occupies two spaces in different parts of the Garden on the main floor, and shows one vehicle in the loan collection of the Automobile Club of America in the annex. It also has several vehicles in the space which is provided as a repository for vehicles that are to be used on the track which encircles the main exhibition floor. In all, the company exhibits some 18 to 20 vehicles. This exhibit includes a light runabout, and two victorias of a style already familiar. There is a station cab for public service, which has an underslung battery equipment, and a square-front brougham for private use. An ambulance is also shown. Also an emergency wagon, which is provided with a sand box and conducting tubes arranged to guide the sand from the box to and under the back wheels. In this vehicle, which weighs some 6,400 lbs., and has a speed of 12 miles an hour, the sand box arrangement will probably be found a very serviceable adjunct. Close to the emergency wagon is a 20-passenger omnibus of very handsome design, and near by a 4-ton truck. A 2-ton truck and a piano box runabout are stored in the space at the back of the Garden for use on the track. The Riker racing machine, which won the Blanchet Cup in the 50-mile all-America race last spring, is shown in the annex. The company also exhibits a break with seating capacity for 12 people besides the operator, which, it is claimed, has a speed of 12 to 14 miles per hour. One of the newest and by far the most elegant electric vehicles shown at the show is the "Victoria de Luxe" of this company. It is a beautiful example of the carriage builders' art and its lines are the most æsthetic that the writer has yet seen embodied in a horseless vehicle. The body is supported on its own separate springs, and it is suspended from these springs by straps, as in the familiar horse-drawn Victoria of the same style. The battery, which is divided into two sections, is carried on springs which rest on the running gear. Thus the body of the vehicle is entirely separate from the running gear, battery, or driver's seat. This gives it all the lightness and ease which would be possible in a horse-drawn body, and at the same time the luxuriously steady motion not possible of attainment with a horse-drawn vehicle. The Riker Company has made no perceptible change in its well-known mechanical features.

The next largest exhibit of electric vehicles is made by the Electric Vehicle Company, of New York. This company exhibits some 15 vehicles in one space, including two delivery wagons with underslung batteries, a straight-front brougham, an extension-front brougham, a cabriolet and a rear-foot victoria. This latter is one of the newer creations of this company, and is a very pleasing looking vehicle. Besides the above, the company also shows a hansom such as New Yorkers are familiar with, a theatre bus, a phæton, a four-passenger surrey, a small victoria, a runabout, a wagonette and a touring car. The latter, it is claimed, has a possible mileage quite beyond any which it is possible to obtain with the standard designs. It has a very long battery box and seating capacity for but two people. This company also has several vehicles in the back of the Garden for use on the track.

The National Automobile and Electric Company, of Indianapolis, has the third largest exhibit of electric vehicles. It shows, in all, seven different styles in its stationary exhibit, and keeps several other vehicles in the back of the Garden for use on the track. This company, which is one of the latest to enter the commercial field, makes a strong showing for such a young aspirant for automobile honours. It exhibits three runabouts, a stanhope, a park trap, combination delivery, and a four-passenger break. All its vehicles are equipped with but one motor, whose curves indicate very high efficiency. Its light road wagon, equipped with a ½-H.P. motor, for which 88 per cent. efficiency at normal load is claimed, shows, perhaps, the greatest variation in design. Its weight is approximately 1,000 lbs., and it has no reach. The body is carried on a system of X and elliptical springs. The driving is accomplished through the front and rear elliptical springs, it is claimed. The result is a very easy carriage, especially on rough ground. The construction is very light and simple. The front axle is hollow, and the motor is spring suspended, and drives from both ends of its shaft. The differential and band brake are both on the armature shaft, and are protected from dirt and moisture by the same case as is used to protect the motor. A rocker plate is used in connection with the rear X spring support, which gives flexibility to the system. A novel way of lubricating the motor bearings is employed. A chain is used instead of the usual metal ring so much employed in stationary motors. The advantages claimed are those of less space occupied and more positive action. The back axle is solid, and the gear cases are made of heavy sheet metal, so arranged as to be easily removed for inspection. They are made adjustable, to allow the substitution of different sized pinions. This company also provides an electric brake of a very ingenious construction. In fact, it is an emergency switch, locking device and electrical brake, all in one. The handle which operates it is conveniently placed within a few inches of the controller handle, and things are so arranged that the handle works up and down in a perpendicular plane. To operate the brake the handle is pushed down past one, two, three or four notches, as circumstances demand. When the handle is pushed down to the first position the current is cut off from the motor, no matter in what position the controller handle is. Hence, the first position serves as an emergency switch. There is a lock provided in the top of the handle which, if turned with the handle in this position, will effectually prevent the vehicle from being stolen when left in the street unattended. Pushed down past the first notch to the second position, the switch throws the armature of the motor in series with a resistance. The motor then acts as a dynamo, and tends to retard the vehicle. Before the electric brake handle can be pushed past the first to the second position, however, the controller handle must be brought back to its zero position. If the hill is so steep that the vehicle reaches too high a speed with the electric brake handle in the second position, it can be pushed down to the third position. With the arrangement of the resistances in this position, more work is done by the dynamo, and consequently the speed of the vehicle is retarded. If the third position of the handle does not cut the speed down to that desired, the fourth one is available. With the electric brake handle in the fourth position, it is claimed any hill may be descended in perfect safety, and, of course, without wear on the brake shoe or brake band operated by the foot, one of which kind is always provided.

The American Bicycle Company, manufacturer of Waverley electric vehicles, exhibits five electric vehicles. It shows a four-passenger brake, four-passenger surrey, road wagon, combination delivery wagon and a six-passenger brake. The new style piano box road wagon, just turned out by this company, is a very neat little vehicle. It is said to weigh less than 1,000 lbs., and is equipped with a 2-H.P. six-pole motor. Its battery equipment is 40 cells of 30 ampere-hour capacity, the total weight of which is said to be 360 lbs. The cost of such a vehicle is but $750, which is a great point in its favour. This vehicle is built without a reach, and the back axle is of a somewhat new design in electric vehicles, though in a general way similar construction may be noticed in several of the light vehicles exhibited that use steam as a motive power. A good point which is incorporated in this vehicle is the use of a brake rod to connect the foot brake attachment with the band. This seems better practice than to employ a light wire rope, as is done by several firms with their lighter vehicles. An interesting little point which shows the refinement of detail that is beginning to be introduced into the horseless vehicle industry is the arrangement of the little incandescent light which is used to light up the dial of the volt and ammeter used on this vehicle. The switch is so arranged that a slight pressure of the left foot of the operator on it closes the circuit and lights the lamp. When the pressure is removed the circuit is opened automatically by means of a spiral spring suitably placed with respect to the plunger of the switch. This little road wagon is one of the style noted above that is making its appearance for the first time on a large scale at the show, and it is to be hoped that this style will be exploited extensively, as it makes a very neat and desirable little trap.

The Woods Motor Vehicle Company, of Chicago and New York

exhibits five vehicles. It has, however, a large number of vehicles of various makes in the back of the Garden for use on the track. It shows a stanhope, station wagon, runabout, brougham and victoria. Its victoria is a very fine specimen of the carriage builders' art, the iron work on the reach being an especially good piece of work. This company shows no new designs. Those exhibited are already familiar.

One of the smallest and lightest, but by no means the least interesting of the electric vehicles exhibited, is the little piano box road wagon made by the Baker Motor Vehicle Company, of Cleveland. This little vehicle has a carrying capacity of two persons and weighs complete but 550 lbs. it is said. The battery equipment is 10 Willard cells, which are placed out of sight under the seat. The battery is divided into two trays of five cells each, and the vehicle has two speeds of six and 12 miles an hour. A ½-H.P. motor is used of high speed, and the power is transmitted to the rear axle by means of a chain and sprocket. The arrangement of the frame is very closely approximate to that used, and now so familiar in the light steam runabouts seen so often on our streets.

The Buffalo Electric Carriage Company, of Buffalo, N.Y., exhibits three of its Buffalo stanhopes, and has one in the back of the Garden for use on the track. The particular features of interest in this carriage are two. The first is the use of wood reaches, which it is claimed add elasticity to the movement of the carriage. The reach is made of hickory, and it is claimed as an advantage of this construction that it can, if necessary, be repaired by any country blacksmith. The second feature in this vehicle is the use of a construction which uses no tubing. The motor is hung as in two of the other makes already noted, close to the right-hand wheel, the object being the same as before, namely, the use of a solid rear axle.

Taken as a whole, the first annual automobile show held under the auspices of the Automobile Club of America is a very great success. It has shown that an art, which but a few years ago was practically unknown, has sprung up and that it has been developed into a strong and rapidly expanding department of industry which in a few years bids fair to rival some of those many years older. It is, however, noted by the N.Y. *Sun* that even while the Automobile Show was in progress a movement was on foot among the manufacturers to do away with such affairs in the future. Attempts will be made to form a federation among the makers, possibly an organisation similar to a board of trade, with an agreement not to patronise shows after a given date. The reason for this step is to be found in the experience of bicycle manufacturers, who for years were heavily mulcted by show promoters in various cities. So long as a few of the leading makers engage spaces at a show all the others feel obliged to be represented. In consequence of this, shows have been a heavy drain on cycle makers. It is expensive to hire space in a hall for a week, pay for decorating and lighting the booth, for transporting the exhibits to and fro, and, more than all, to distract the attention of principals and employés from their regular duties for 10 days. The plan formulated by a few and in which an effort to get all others to join will be made, is to start a big train of automobiles around the country next March. The train will visit all cities of consequence and remain from one to three or four days in each, in order that the natives may inspect the automobiles and have them explained to them. It will be a peripatetic show that will cover the whole country and it is thought will accomplish more with no greater expense than going into one show after another.

LONDON COUNTY COUNCIL.

The Fire Brigade Committee reported, at a meeting of the London County Council on Tuesday, that there was on exhibition in the lobby a specimen of the direct current telephone devised by Commander Wells, and which is in future to be used in cases in which the owners of buildings may be permitted to place them in communication with the Fire Brigade.

Underground Electric Railways.—On the motion for the reception of the report of the Highways Committee, Mr. Leon referred to the Bills now being promoted for the construction of underground electric railways in London. He said it was time the county had some general system which would render underground traction more useful to London, and he suggested that the Highways Committee should act as the guide of the Council as to what steps should be taken in the matter relating to the private schemes. In reply, Mr. J. W. Benn stated that the Council had very little control over the underground electric railways. Of course the Council could oppose any of the Bills in Parliament, on the plea that some general system should be settled before the lines were decided upon. That was an important matter, and he did not know whether the Highways Committee could take the initiative in that direction. The chairman, however, promised to make inquiries into the matter, and if anything could be done he would report to the Council on a future occasion.

Electric Tramways.—Mr. Boulnois asked the chairman of the Highways Committee what would be the cost of the experimental lines proposed for South London in the Committee's report submitted that day, and whether the Finance Committee had reported on the question. In reply, Mr. Benn stated that the estimated cost of the experimental lines had already been placed before the Council in the report submitted by Prof. Kennedy. The amount was approximately £15,000 per mile of single and £30,000 per mile of double track, and the Finance Committee had approved those estimates.

The report of the Highways Committee reminded the meeting that the Council is authorised by the London County Tramways (Electrical Power) Act, 1900, to adopt and use with the consent of the Board of Trade electric traction on the tramways which have been or shall be acquired by the Council, or which shall be constructed by the Council under the powers of any Act of 1900. The report proceeded to state:—"The London County Tramways Act of 1900 authorised, among other things, the reconstruction, for electrical traction, of the tramways between (*a*) Westminster Bridge Road and Upper Tooting Road (the reconstruction in this case to be carried out within two years from January 1st, 1901), and (*b*) Kennington Park Road (at its junction with Kennington Road) and the terminus in Blackfriars Road, near the bridge; and we think that the reconstruction of these lines, and also of the lines connected therewith between (*c*) St. George's Circus and the terminus in Waterloo Road, should be first proceeded with. Dr. A. B. W. Kennedy, the expert electrical engineer employed by the Council, has prepared and submitted to us a description and drawings of the underground conduit system of electrical traction which he has devised, and recommends should be adopted, for the three lines of tramways; and, after full consideration, we have approved the system. We are of opinion that the reconstruction of the three portions of line above specified should be commenced with as little delay as possible. The first step necessary to be taken with the view of attaining this object, is for the description and drawings to be submitted to the Board of Trade for its approval, as required by the Acts; and that the Councils of the Metropolitan Boroughs of Lambeth, Southwark, and Wandsworth, which, as the road authorities concerned, are interested in the matter, should each be supplied with a copy of the description and of the drawings, in order that those bodies may, in accordance with the Acts, have an opportunity, should they or any of them so desire, of making any representations to, or of asking to be heard by, the Board of Trade with regard to the proposed system."

The Committee submitted recommendations to this effect, and these were adopted without discussion.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Sir W. H. Preece might well express his delight at the crowded audience which mustered in the hall of the Institution of Civil Engineers on Thursday of last week to listen to Mr. John Gavey's paper on "Telegraphs and Telephones at the Paris Exhibition, 1900." Opening the discussion, Sir W. H. Preece said it did his heart good to see such an assembly gathered to listen to an address on telegraphic matters, and considering that every seat was occupied and a number of late comers had to line the walls, the comment was fully justified. He wondered if young members of the Institution ever read the earlier volumes of the *Proceedings*. By doing so they would be saved from many troubles. He referred to the papers previously submitted to the Institution on the exhibits at the Munich, Vienna, Paris, Philadelphia, Vienna, and other Exhibitions, and hoped that every advantage would be taken of progress in other countries; we are not yet behind our foreign competitors, but should be if we did not look out, a remark appreciated by the older members present. He reminded his hearers that the growth of a business depended upon the growth of a capacity to conduct that business, and this was true, not only of telegraphy, but of traction, and all branches of electrical industries. Twenty-three years had elapsed since the telephone was brought over to this country. Was the telephone industry now in a flourishing condition? The National Telephone Company was trying to maintain a difficult position; municipalities were trying their hands at the business, while a "small department," called the Post Office, was also doing something, and had a good opportunity, if only that it had a broad back to bear the greatest possible abuse. In the paper Mr. Gavey referred to the City of Mexico, where eight companies were at work. Sir William envied the position, as here the difficulties were bad enough, with only three competitors. If any business should be managed by one concern, it was that of telephony. He was afraid that he would not see what he longed for, the carrying of a telephone into every house.

Mr. Roberts criticised the Exhibition catalogue and the attendants' knowledge of the exhibits they were at the Exhibition presumably to explain, and wanted Mr. Gavey to state the most marked improvements he noticed in telephonic and telegraphic apparatus. Mr. A. W. Heaviside wanted data of the Delany multiplex telegraph, and of the Row-

change in its well-known mechanical features.

The next largest exhibit of electric vehicles is made by the Elec-

sively, as it makes a very neat and desirable little trap.

The Woods Motor Vehicle Company, of Chicago and New York

land's system, and discussed the carbons used in microphones. Mr. Dane Sinclair criticised the common battery system of telephony, which was ably defended by Mr. J. E. Kingsbury, who thought there were no conditions known to telephonists that the central battery system did not meet. One or two general references were made to wireless telegraphy, particularly as to the details of the Slaby and D'Arco system mentioned in the paper.

Mr. Gavey, in his reply, urged that his paper should be considered as suggestive rather than as stating too definitely what improvements were made or shown, and was of opinion that very marked improvements in our methods of telegraphy were looming in the immediate future, the Morse system not being quite up to our modern requirements. In telephony he considered that no other improvements were possible than in detail, but during the last four or five years the improvements had amounted to a revolution.

The Poulsen microphonograph came in for a general round of flattering comments. Sir W. H. Preece characterised it as the greatest novelty at the Exhibition ; a very marvellous thing based on beautiful principles, but he had not seen it at work. He thought nothing so marvellous as these curious changes of motion and shape which sometimes are called electric and at others magnetic. Mr. Dane Sinclair claimed to have gone one better than Sir William, as he had seen it at work and knew all about the pretty and wonderful thing. It gave a record so clear that it could not be compared with any other apparatus ; the message was received back absolutely pure. If it gave us a telephonic relay it passed out of scientific to practical and commercial interest, and then the heavy conductors, thought necessary for telephony, would no longer be required. Mr. W. J. Hammer thought the name of the apparatus was telephonograph when he saw it in Berlin. He noticed that the objectionable scratching of the phonograph was entirely absent, and that it gave most perfect reproduction, and was superior to anything yet made in the way of a talking machine. Prof. S. P. Thompson bore testimony to the extraordinary goodness of the combined telephone and phonograph, but it was called the telegraphone when he met with it.

The references to the electrical units proposed by the Paris Congress were directed to the terms gauss and maxwell. Sir W. H. Preece doubted if the latter would come into practical work, but the former might, while Prof. S. P. Thompson thought the profession had been endowed with a great boon in the gauss, as instead of talking of ·18 hung up in the air, as it were, one could say ·18 gausses. On the other hand, he did not see that the term maxwell was any easier to use than " magnetic line," and megaline was more convenient than megamaxwell.

CORRESPONDENCE.

Precautions against Electric Shocks.

The recent fatal accidents due to electric shock, naturally raise in our minds questions as to the efficiency of the measures adopted to prevent such recurrences, and we are apt to examine more closely (for a time at least) the advisability of improving on such precautionary methods.

Since the introduction of high pressure systems of generating electricity, the principal safeguards against accidents among the staff have been the provision of rubber gloves and mats, with special injunctions for their use when handling charged metal. Fatalities have, however, occurred which have thrown blame on the victim, the switch-gear and the gloves alike, with subsequent improvement to the switching arrangements, perhaps, but with little effect on the staff or the gloves.

In many cases the use of gloves is considered to be sufficient protection, but there are instances when their use is impossible and also a real danger. When making any alteration in a hurry, the gloves render the operation most awkward and difficult to accomplish, the screwing on of a small nut, for instance, which can hardly be felt with the gloves. The very nature of the latter makes the fingers all "thumbs," and ofttimes drives the electrician to casting them aside, with a determination to chance his luck without any protection whatever. This can only be realised by those who have to make use of gloves, and who are better acquainted with some of their faults. When working with sleeves rolled up, the handling of a long spanner, with a glove on the hand, is no safe operation. The spanner is more readily used by being grasped about the centre (especially if it be a double-ended one), and the tightening of a nut will, with every movement, bring the end of the spanner in dangerous proximity to the elbow or forearm. It is a small circumstance, and is easily passed unnoticed, but a man's life will hang in the balance during the operation, which he may consider himself performing with safety. The use of gauntlet gloves will no doubt be suggested as a way out of the difficulty, or working with the coat on. The latter suggestion goes for very little, as the Newport accident has shown ; moreover, when working behind a switch gear, the confined nature of the operations is not conducive to the wearing of superfluous clothing, especially as circumstances prove that such clothing affords no protection.

Again, when using gloves, the close texture of the rubber confines the perspiration (increased by reason of the danger involved) of the hands to such a degree that the interior of the gloves becomes quite wet. Consequently whatever insulation they may afford, the moist state of the hands increase the liability to shock should the rubber become pierced or be defective. When a man is in a hurry he has no time to examine gloves for defects, such as pin holes, thin places, &c. ; he snatches up the nearest to hand, thinking only of his particular duty, and is heedless of his danger. These are the occasions when accidents occur and are the least preventable.

Probably the best evidence against the use of gloves is that recently given by a witness in the Newport case, where a statement was made to the effect that a man could work better without gloves, and that he (witness) would hold this opinion unchanged in spite of the accident, and should continue to act up to it. The hidden danger in their use has, no doubt, brought many other electricians to a similar conclusion.

Dangers of a like nature lurk in the employment of rubber mats. Such contrivances are useful only in insulating from earth, so that on a double-pole board they are worse than useless. With single-pole gears they only protect the soles of the feet from earth contact, other portions of the body being liable to touch a wall or girder especially as the mat gives a false notion of insulation from earth. It is under these circumstances that a man is "sold." Similar arguments apply against insulated platforms.

It will be gathered from the above that the usual precautions prove in general practice but snares which catch in a most unexpected manner even skilled men, and the question naturally arises, What other methods can be adopted to protect electricians? That such methods are possible a little examination will show. The use of double-pole gears is certainly a great source of danger, as the proximity of metal parts having great differences of potential increases the possibility of shock from falling against the gear. This difficulty can, however, be got over quite easily by making the board single-pole, *i.e.*, earthing one pole and carrying out all switching arrangements on the other. A carefully insulated platform is rendered necessary by this arrangement which need, however, present no obstacles.

A greater source of danger is a combination of double-pole connections and a passage at the back of the board. It is here that the trouble mostly occurs. A man has hardly elbow room to work, while under his nose are terminals and contacts having great potential differences between them. The effect on a fellow's nerves is not to be lost sight of, and a little consideration will show that any man's natural nervousness will not be improved under the circumstances.

However, as with the double-pole difficulty, so with the connections at the back. They are no longer necessary. Switch-gears can now be obtained which have no rear connections whatever, and experience with this class of gear has shown that older methods are no longer justifiable on grounds of safety. At the same time, such boards must be handled under current at times, and a word may be said here for

insulated tools in carrying out the necessary adjustments. These can take the shape of insulated spanners (most commonly used tool) which are preferably of the "box" type, as the hands can be kept clear of the gear when unscrewing, and the nuts will be found to wedge themselves in the "box," so that no gloves are necessary to remove or replace such nuts or screws. A carefully insulated floor will then give ample protection for the use of insulated tools.

Similar methods can be adopted in sub-stations where high-pressure metal has to be handled.

Happily, fatalities are of rare occurrence, and improvements are being more and more effected towards absolute safety from shock, but such improvements should be taken every advantage of by engineers, who, perhaps, in thinking they can continue as they have done heretofore without accident, are really endangering the lives of their assistants, and casting cold water on laudable efforts at rendering high pressure generation a safe operation. When facilities are offered for such a purpose, no effort or cost should be spared in embracing them, and when this is done the days of fatalities from electric shock will be left far behind us.

W. E. Warrilow.

I note "there is a saddening monotony" about one portion of inquiries into fatal accidents, as the result of electric shock, viz:—The person who has unfortunately lost his life, according to the evidence, is invariably to blame.

Considering (in some provincial H.T. supply stations) the bad equipment of sub-stations and street transformer tanks, and the fact that high and low tension cables are, in many cases, drawn into one box, I often wonder there are not more fatal accidents.

I know of an instance which came under my notice a few months since, where a H.T. concentric cable, and six or eight low tension cables were drawn into one box; the H.T. cable was feeding a transformer some 10 yards from the draw-in box. Eventually the transformer was fed from another source. Instead of this H.T. cable being disconnected from the primary terminals, it was cut in the draw-in box; the long length drawn out, the short length from draw-in box to primary terminals of transformer left in, with end of cable protruding into draw-in box.

Workmen were frequently sent to this box to connect and disconnect portions of the low tension network.

Eventually a workman received a shock from this end of the H.T. cable, which fortunately did not result fatally.

The engineer was aware that this piece of cable had been left in.

I consider that all sub-stations, &c., should be periodically visited by inspectors appointed by the Board of Trade.

Distribution.

Your leader under the head of "Supply Station Accidents" has appealed to me very strongly, as it must have done to any of your readers who are responsible in any way for the working or design of switchboards for high voltages. So much has been learnt in recent years, and so many improvements made in the design of such switchboards, that it is truly awful to know that fatal accidents on them repeatedly occur.

Why are boards allowed to exist with death-traps at the "back"? Where there is not sufficient room for even one man to work safely, supervision is certainly difficult and involves terrible responsibilities. The chances of a workman, or even a technical person, touching metal parts (which always look so harmless) are very great indeed. It is wrong to have exposed metal parts at the back, but worse to have them also unshielded on the front.

We cannot do without high tension switchboards, but we can:—(1) Abolish the "backs"; (2) have no metal frames near H.T. conductors; (3) shield all connections and fittings; (4) and yet make them visible from the front.

Mr. Ferranti showed the way several years ago.

Safety in switchboard work is possible. It involves very careful design, with scrupulous attention to even the smallest detail or connection; probably increasing the prime cost, but this additional value can in no way be compared with the life of the poorest man. I hope, therefore, that your timely warning will not only impress those actually working in central stations, but those Councils, Committees, and Engineers who have the responsibility of selecting the plant. It should also impress British designers, and induce them to simplify and safeguard their work, which would also prevent the importation of central station appliances from other countries where life is perhaps cheaper than our own.

In conclusion, I would point out that where old dangerous switchboards exist, the only safe remedy is to replace them entirely. The process of patching up and shielding would further endanger life and make the cure worse than the disease.

Henry W. Clothier.

Aluminium Soldering.

With reference to Mr. King's letter in your last issue, on the subject of aluminium jointing, although not directly interested in the manufacture and jointing of aluminium conductors, I should nevertheless be interested in experimenting with the composition named, and should esteem it a favour if Mr. King would kindly obtain a sample for me, which I will try and report upon in due course.

The subject of successfully soldering aluminium is an important one, and, if satisfactory, will tend to widen the field of application of this useful metal.

J. Wright.

Electrical Vehicle Trials.

Although the electrical vehicle trials recently undertaken on the initiative of the Automobile Club of Great Britain were the means of bringing together a good many competitors, there are very many points in connection with them which are open to criticism and the serious consideration of every one really interested in the electrical vehicle industry—not only interested in a transitory way, but especially of those who, whilst thoroughly believing in the practicability and ultimate general use of such vehicles, desire that they should only be put to such uses as they are really suited for.

That such a district as Chislehurst should have been chosen is alone a matter of great surprise, as no engineer who is thoroughly conversant with the electrical accumulator or secondary battery could conscientiously recommend a person residing in this or any similar district to use an electrical carriage, without pointing out the very heavy expense entailed in the upkeep of the batteries resulting from the very heavy discharges necessary to propel the vehicles on account of the condition of the roads and the steepness of the hills.

Of course in summer time and dry weather the deterioration of the plates would not be so serious, but one wants a carriage in winter time as well as in summer.

Although many of the vehicles entered got through the trials in a very satisfactory manner, no useful purpose can possibly be served by foreing a car over the hills at Green St. Green and Knockholt, and what would be the condition of the batteries if these tests were continued daily for, say, only 20 days? To give an illustration of the difference in the demand upon the cells when used as they should be used at somewhere about their normal discharge rate and under such conditions that the up-keep of a set of cells shall not reach a prohibitive sum, but shall be within, say, £20 per annum, a small electrical carriage, seating two, was taken over the same roads a few days ago—that they were in a worse condition than on the days of the trials may be admitted, as there had been continuous wet weather for some five or six days since that time.

The weight of the carriage complete is 19 cwt., of which the cells weigh 7½ cwt. The two passengers weighed 2¾ cwt. Now this carriage takes 23 amperes at 80 volts when run on a level hard road, and travels at 13 miles an hour; but when run on the route F., of flat (*sic*) or nearly flat road, the average consumption of current was 45 amperes, the maximum being 70.

That there was one continuous half-mile of flat road is open to doubt, and to those who may be unacquainted with Chislehurst, but who know London, it may be pointed out

that on the following day the same car was driven up Pentonville Hill, Islington, and the maximum current taken was 58 amperes, the average being 45, and the speed eight miles an hour. This will give one a fair idea of what some of the flat (*sic*) roads were like which were chosen for these trials. No alterations or adjustments of any description were made to the car or the battery, which was charged at Chislehurst, and during the run over the route the car was in perfect order—no hot bearings, no sparking brushes, nor any other defect, only that of the bad roads to account for the large output required.

The car was driven from London *viâ* Camberwell, Denmark Hill, Half Moon Lane, College Hill, Crystal Palace, down to Penge, through Bromley, Swan Hill, Bickley and Old Chislehurst Hill to the Bull's Head. On this last hill the current taken was 95 amperes.

Many thanks are due to the club and to those gentlemen who, at very great personal inconvenience and discomfort, undertook the varied duties in connection with the trials; but why the probable competitors were kept in the dark as to the routes and district chosen until the eleventh hour, and were not consulted, as was the case when the 1,000-mile run for the oil motor vehicles was arranged, is a matter which perhaps may be explained at a later date, although it has been suggested by a cynic that the absence of the public from the trials was a matter for congratulation, in view of the rumours one hears of the friendly aid of the horse required by some of the competitors.

If there are to be trials in the future, and it is earnestly hoped that this one is only the first of many, let them be arranged so as to be carried out under those conditions which the true friends of this growing industry can safely advise—under such conditions as can be carried out day after day without ruining the batteries, and on good roads, whether wet or dry does not matter much, as long as they are hard (and your tires do not pick the road up, as they pass over it, in lumps), and in London to be preferred.

For town use alone the field is large enough to recommend their use, for long country drives it is a mistake. There are too many difficulties in the way, such as the charging of the cells and consequent loss of time whilst this is being done, and the fewness of charging stations—although this latter difficulty will be removed as time goes on, and when, as on the Continent, nearly every little village has its own electric lighting station.

Carl Opperman.

Once Bitten ——.

Having seen the letter signed "One of the Six" in your issue of November 23rd, I wish to say that having had the misfortune to be also "one of the six," I can thoroughly endorse what your correspondent says.

Like him I crossed the Irish Sea, having been told that my second-class fare would be paid (which I supposed meant my out-of-pocket expenses), and if I am not very much mistaken, your correspondent and myself came back together, and I well remember the variety entertainment he refers to.

Like him I received a cheque for my second-class fare only, and did not get even this until three weeks after my return. It seems to me that it is hardly fair for engineers (who are never blessed with too much of the good things of this world) to be invited to attend a meeting of a governing body who wish to appoint an engineer, and be out of pocket by the transaction, although they attend altogether for the convenience of that governing body.

Another of the Six.

110-volt v. 220-volt Supply.

With reference to the interesting data given by Mr. Boot on the above subject, I would be glad if he would give some particulars as to the cost of production extending over the same periods as in his other tables.

Of course, it is evident that the saving to consumer by changing the method of charging would be very considerable, as the rebate point would only be reached under the old system when a lamp (8-C.P. = 30 watts) had burned 533 hours in the winter half-year and 133 hours in the summer half-year, whereas under the "maximum demand" system the rebate point will be reached when a lamp has burned 182½ hours in each half-year, *i.e.*, from January 1st till June 30th, and from July 1st till December 31st.

T. H. McMurray.

Belfast, *November 26th*, 1900.

Vibrations caused by Motors.

We are extremely obliged to your correspondent, Mr. Sherard Cowper-Coles, for his article in your last week's issue *re* "Vibratory Movements in Electric Motors." As we are now placing our "anti-vibration" frame on the market his remarks have come just at the right time.

Middleton Bros.

Chelsea, S.W.

LEGAL.

Hawkes *v.* The Leyton Urban District Council.

In the Court of Appeal on Tuesday, before the Lord Chief Justice and Lords Justices Rigby and Vaughan Williams, the case of Hawkes *v.* the Leyton Urban District Council came on for hearing on appeal by the defendants from an order of Mr. Justice Buckley, who had granted the plaintiff an injunction restraining the defendants, their servants and agents from carrying on their electric supply works at Leytonstone so as to cause a nuisance by vibration and noise to the plaintiff as owner and occupier of premises in Cathall Road, Leytonstone. The defendants admitted that there had been noise and vibration, but pleaded that since alterations at the works the nuisance no longer existed. The plaintiff, however, alleged that the noise and vibration caused by the engines was still sufficient to establish a case of nuisance, and Mr. Justice Buckley being of the same opinion, granted an injunction, which the defendants now sought to have discharged.

Mr. H. Terrell, Q.C., who, with Mr. Dibden, appeared in support of the appeal, said the defendants, as the local authority, had, under the Electric Lighting Acts, the duty cast upon them of establishing electric lighting works for the neighbourhood of Leyton and they had, in fact, established very considerable works, the whole of the streets of Leytonstone being now lighted by electricity. The advantages of the electric light were so soon appreciated in Leytonstone, nearly everybody requiring to be supplied with the electric light, that there was thrown upon the works very extraordinary labour in providing an adequate supply. In the first instance, the defendants worked their machinery by means of gas engines. They commenced with two engines, increased the number to four, subsequently added another pair, and ultimately they had eight gas engines at work. With all these engines, however, they were not able to cope properly with the inordinate amount of light required, and they accordingly erected a steam engine as a sort of stand-by. In the working of gas engines something occasionally goes wrong, and there ensued what was called "back-firing."

Lord Justice Rigby: What is back-firing?

Mr. Terrell said it was an explosion at the wrong side of the piston. At times, especially on Saturday nights, when the electric light requirements were very great, this back-firing took place, and they were unable to take off the engine at once or the supply would have been insufficient.

The Lord Chief Justice: Is it your case that back-firing must take place?

Mr. Terrell said it was not. In the case of all gas engines regularly worked there would be instances from time to time of back-firing, but the moment it occurred it was usual to take off the engine. In this case he admitted that until 1899 the engines were at times over-worked, and they were not able to take off the engine on which back-firing occurred.

The Lord Chief Justice: I suppose the decision against you was both on the ground of noise and vibration.

Mr. Terrell said that was so. The plaintiff's premises were some 200 feet away from the works. He was a horse dealer, and had a residence there as well as some stables. His case shortly was, that it was only occasionally that there was an explosion, and that therefore no injunction ought to have been granted; and, further, that under all the circumstances the injunction was far too wide, and that it ought to have been limited to the use of particular gas engines, so as to obviate the nuisance caused by back-firing. It was also part of his case that alterations had now been effected which would do away with the noise and vibration complained of. When the action was commenced the defendants were in course of erecting steam plant which, to a great extent, would obviate noise and vibration, but in the Court below he pointed out to the learned judge that as the explosions were only intermittent, and not continuous, the case was not one for an injunction in the very wide terms in which it was granted. The injunction, as it now stood, would apply to any machinery employed by the defendants, steam or otherwise, and whatever they did hereafter the plaintiff might turn round upon them and attack them on a motion to commit. At the present time two additional steam engines were actually at work, and two more were on the premises, and would be set to work in the course of a few weeks.

The Lord Chief Justice: Are these steam engines only to be standbyes?

Mr. Terrell said it was proposed to work the steam engines as the main plant, but the gas engines would be worked as a sort of auxiliary plant. Of course, in the event of back-firing occurring, they would at once be able to take off the engine.

Lord Justice Rigby: As to the terms of the injunction, you apparently suggest that the case as to the gas engines should be determined first, and that in the event of any complaint as to the steam engines, there should be a separate trial.

Mr. Terrell said that was his point. The matters were entirely separate, and would necessitate the calling of distinct expert evidence. He was perfectly willing to let the injunction go if it was limited to the noise and vibration caused by the back-firing of the gas engines, but in no case ought the injunction to be continued in the very wide terms in which it was granted. His main point, however, was that where there was merely temporary, and not a continuing noise, it was not the practice of the Court of Chancery to grant an injunction.

The Lord Chief Justice: You cannot contend that electric lighting stations must be a nuisance. They are all over the place, and no doubt have cured their nuisances. You must make out that there is not a nuisance to justify us interfering.

Mr. Terrell: I say it was only temporary and occasional, and due to extraordinary circumstances. That is the whole point.

On Thursday the Lord Chief Justice, after hearing further argument, gave judgment. He said that the terms of Mr. Justice Buckley's order were too wide; the order should be limited to one restraining the defendants from carrying on their business so as to cause nuisance to the plaintiff by the use of gas engines. Defendants were not, however, allowed the costs of the appeal.

BUSINESS NOTES.

"Universal Electrical Directory (1901)."—We are asked to announce that, in order to publish on January 1st, the latest date for receiving new matter for advertisements has been fixed for Thursday, December 5th. Those who have not already notified their requirements are asked to note this date. Matter received after the 5th can only be dealt with in the addenda.

Electrical Wares Exported.

Week ending Nov. 28th, 1899.		Week ending Nov. 27th, 1900.	
Adelaide	Value £75	Adelaide. Teleph mat.	Value £500
Alexandria	284	Alexandria	78
Amsterdam	25	Amsterdam	107
Barbadoes	20	Beira. Teleg. mat.	160
Buenos Ayres. Teleg. mat.	742	Bilbao	402
Calcutta	236	Bombay	425
" Teleg. wire	204	Buenos Ayres	84
Cape Town	310	" Teleg. mat.	81
Christiania. Teleg. wire	31	Calcutta	360
Colombo	217	Cape Town	393
Copenhagen. Teleg. wire	49	Christchurch	223
Durban	169	Colombo. Teleg. mat.	101
East London	74	Copenhagen. Teleg. wire	141
Genoa. Teleg. wire	70	Durban	201
Hong Kong	145	East London. Teleg. poles	259
" Teleg. mat.	8	Fremantle	12
Lyttleton. Teleg. mat.	2,910	Gibraltar	16
Madeira	80	Hamburg. Teleg. mat.	800
Madras	28	Karlskrona. Teleg. wire	107
Melbourne	141	Lisbon. Teleg. mat.	40
" Teleg. wire	1,001	Manila	27
New York	24	Melbourne	51
Ostend	116	" Teleg. mat.	805
Otago	14	Montreal	150
Port Chalmers	210	Nagasaki	60
" Teleg. mat.	2,710	Newcastle	32
Port Elizabeth	377	Ostend	1,093
Rio Janeiro	27	Port Elizabeth	153
St. Helena. Teleg cable	136,000	Port Said	125
Shanghai. Teleg. wire	137	Rosario	457
Singapore	45	Rotterdam. Teleg. wire	59
Stockholm. Teleg. mat.	45	Shanghai	185
Sydney	459	Singapore	36
" Teleg. wire	588	Stockholm. Teleg. wire	16
Tokio	80	Sydney	979
" Teleph. cable	1,412	Trieste	29
Trinidad	98	Wellington	25
Wellington	41	Yokohama	88
" Teleg. mat.	473		
Total	£149,580	Total	£8,344

The Ardross Castle Installation.—With reference to the article which we published last week regarding this interesting installation, we omitted to mention that the makers of the switchboard apparatus and electrical parts of the automatic appliances were made by Messrs. Nalder Bros. & Thompson. The working out of the details of the automatic appliances necessarily involved a good deal of thought and trouble, and the success attained is largely due to Messrs. Nalder's care in design and construction.

Auction Sales.—Messrs. Wheatley Kirk, Price & Co., engineering valuers, auctioneers, &c., have sent us a catalogue of their sale by public auction, of electrical and other modern plant and machinery, to be held at the works lately occupied by the Aluminium Company, Oldbury, near Birmingham, on December 5th. It gives plates prepared from photographs of the machinery, also reproductions of indicator diagrams taken from the engines themselves. As a catalogue of a sale by public auction of engineering plant and machinery, we believe this to be unique, and it should serve as a reliable guide to intending buyers.

Messrs. P. Huddleston & Co. will, on December 6th, offer for sale by auction at the Pendleton Electrical Works, Pendleton, Manchester, the stock and plant of an electrical arc lamp manufacturer (*vice* H. V. James and Mills). Particulars will be found among our advertisements.

Bankruptcy Proceedings.—The first meeting of creditors was held on 26th inst. at the Bankruptcy Court under the failure of Frederick Lamplough, consulting chemist and engineer. The debtor in May, 1897, acted as consulting engineer to the Fish Oil and Guano Company, Limited, who were about to promote the Volenite Company, and contracted to erect special machinery. The Volenite Company, Limited, was formed in 1898, and the debtor was appointed as its consulting chemist. He purchased £3,000 shares, and was given a further £2,000 as payment for his services, whilst in July, 1899, he agreed to finance the company. An action was subsequently brought by a creditor of the company, and the Court held the debtor to be liable for the debt on the ground that he had agreed to finance the company. The failure is attributed by the debtor to his liability for the debts of the Volenite Company, and to other causes. Mr. C. J. Singleton is to act as trustee and wind up the estate in bankruptcy, assisted by a committee of inspection.

Dissolution.—Messrs. A. G. Adamson and G. C. K. MacLennan (Adamson Bros., electrical engineers, Christopher Street, Finsbury) have dissolved partnership. Mr. Adamson continues the business under the same style, and will attend to debts.

Catalogues and Lists.—Mr. W. Boby, of Union Court, E.C., sends us several lists of the "Chevalet" heater-detartariser and condenser, which, by the aid of drawings, explain the principle of the system. We understand that the apparatus is now employed in a large number of English electrical works, including the following:—Brompton and Kensington Electricity Supply Company, Messrs. Siemens Bros., Limited, Charlton; St. Pancras Vestry Electric Light Works, Chelsea Electric Light Company, Folkestone Electric Light Works, Bromley Electric Light Company, Newmarket Electric Light Company, Blackheath and Greenwich Electric Light Company, Bury St. Edmunds Electric Light Works, East Ham, Eastbourne, Reigate and Beckenham Electricity Works, Messrs. Reavell & Co., Ipswich, Valparaiso Electric Light Works.

The B.T.H. Company's pamphlet, No. 80, just issued, describes in their usual attractive manner the slow and moderate speed motors of the M.P. type. The features of construction are given and the parts shown by means of excellent blocks.

Messrs. W. T. Henley's Telegraph Works Company have issued a book, the general get-up and binding of which are very pleasing. It is issued with a view of placing before customers and friends and the trade generally an account of some of the work which has been carried out by this well-known firm at their North Woolwich works during the last 50 years. The photographic pictures show the landing and buoying processes of the laying of shore-end cable. A list follows of telegraph cables which they have made and laid in all parts of the world; also names of corporations and companies for which they have furnished and laid underground electric light and power cables. This latter branch of work was taken up in 1882, until which year telegraph cables had demanded exclusive attention. As most of our readers are aware, the business has gone ahead steadily and surely since then, enlarging the scope of its operations and carrying out an enormous amount of work. In telegraph cable manufacture their customers have included the British Post Office, National Telephone Company, and Australian and other Colonial and foreign Governments. From 100 hands 20 years ago to over 1,000 to-day is one indication of the extent of the development which has taken place. Some photographs of the works showing exterior and interior views, also the electrical testing room, are very well reproduced, and they add interest to the book.

Messrs. Holden & Brooke have sent us one of their latest "abridged temporary" catalogues of steam-users' specialities. There is a good deal of new matter, several new specialities being illustrated. Some original tables contain information which has not been previously published regarding the choice of injectors. The Sirius, Premier, Giffard and other injectors are described, also steam dryers, grease separators, feed heaters, pumps, valves, and so on.

Some new lists have just been brought out by the Electrical Company, Limited, of Charing Cross Road. No. 9 is devoted to illustrations and tabulated data and prices of single, double, and treble-pole knife switches, three phase reversing switches, multiple contact switches, maximum current cut-outs, high tension switches for 5,000 to 12,000 volts. No. 13 describes lightning arresters and sundry safety devices. "Rapid" fuses for pressures of 550 volts and up to 6,000 volts; "Slow" fuses with carbon lightning arresters for protection against "creepage" and atmospheric discharges, and combination boards with "rapid" and "slow" fuses for two circuits. List No. 16 is devoted to electricity meters. It opens with general remarks on meter systems, following with a recital of the advantages of oscillating direct current watt-hour meters, a note of the prices and weights, &c., and a description of railway, switchboard, testing, battery, and street lighting meters. A number of very clear diagrams are given of connections and dimensions of direct current meters of various capacities from 75 to 2,000 amperes; instructions for setting and starting certain meters are included, also apparatus for their calibration. Direct current time checks likewise have a place in this useful list. The arrangement of the letterpress and illustrations is convenient.

Fire.—Mr. R. Jenkins informs us that the recent fire at the works of Messrs. Joseph Sankey & Sons does not affect the output of stampings for electrical purposes, this branch of the works being entirely separate, and at least half a mile away from the scene of the fire.

the winter half-year and 133 hours in the summer half-year, whereas under the "maximum demand" system the rebate

premises, and would be set to work in the course of a few weeks.

The LORD CHIEF JUSTICE: Are these steam engines only to be standbyes?

Electric Lighting and Tramway Powers.—Last week under "Electric Lighting and Traction Notes," we gave particulars of a few of the applications which have just been made to Parliament and the Board of Trade for powers. The *London Gazette* for November 23rd contained the following further notices:—

Electric Lighting.—Foot's Cray (Rural District Council); Carnarvon and District (applicant, E. W. I. Peterson, of London); Trowbridge (U.D.C.); Dover (purchase of the Dover Electricity Supply Company by the Dover Gas Light Company); Lowestoft (Corporation extension of powers); Aberdare Electric Lighting Company; Mansfield (various, including electric light and destructor, Corporation); Southend-on-Sea (Corporation, extension of powers); St. Austell (St. Austell and District Electric Light and Power Company); Hoddesdon (U.D.C.); Ware (U.D.C.); Dorchester (Corporation); Workington (Corporation); Hampton (U.D.C.); Tredegar (U.D.C.); Mitcham (Croydon R.D.C.); Honley (U.D.C.).

Electric Tramways and Light Railways:—Eccles Corporation; Finchley and Hendon (new company); Blackburn Corporation (various powers); Kingston-on-Thames; Tyneside (new company); Willesden (U.D.C.); Wigan (Corporation); Bradford (Corporation); Bolton (Corporation); Lowestoft (Corporation); Dartford (U.D. and R.D. Councils); Swindon (Corporation); London County Council (new lines and street widenings); Kingston-upon-Hull (Corporation); Smethwick (Corporation); Blackpool (Corporation, various powers); Birmingham (City of Birmingham Tramways Company); Cheriton (U.D.C.); Littleborough (U.D.C.); Stalybridge, Hyde, Mossley and Dukinfield (Joint Board, tramways and electricity); London United Tramways Company (new lines in London, Middlesex and Surrey); South Lancashire (South Lancashire Tramways Company); West Riding (United Kingdom Tramways, Light Railway and Electrical Syndicate); King's Norton and Northfield (U.D.C.); Scarborough (new company); East Cowes (U.D.C.); Crompton (U.D.C.); West Cumberland (new company); Halesowen (U.D.C.); Liverpool (Corporation extensions); Worcester (Worcester Tramways, Limited); Folkestone (Corporation); Leeds (Corporation).

Electric Railways.—Victoria, City and Southern Electric Railway (to run underground between Victoria, Cannon Street and Peckham); Islington and Euston (underground electric railway); Charing Cross, Euston and Hampstead, No. 1, extension to Golder's Green; No. 2, extensions to Highgate and Victoria; Metropolitan and Metropolitan District Railways, and portion of the L. & S.W. Railway (application by the British Westinghouse Company for certain powers necessary for working by electricity); Manchester and Liverpool Electric Express Railway; Central London Railway (new railways, loop lines, Hammersmith, and under G.E.R., Liverpool Street station); City and Brixton Railway (extension of time); City and South London Railway (subway powers to Agricultural Hall; extension of time, &c.); Metropolitan District Railway (conversion to electric traction, and raising additional capital therefor).

Electric Power.—South Yorkshire Electric Power Company; Yorkshire (West Riding, new company); Derbyshire and Nottingham (counties of), electric power (new company); Cleveland and Durham County Electric Power (new company).

Numerous applications are given in the *Gazette* of the 27th inst. These we shall mention next week.

Correction.—Last week's entry "*Gosport* Electric Tramways (Urban Electric Supply Company)" should have read *Glossop*. As a matter of fact, we understand that the Gosport District Council has made arrangements for purchasing the local tramways for transfer to the Electrical Power Distribution Company, who will supply energy for operating them from the lighting undertaking for which the provisional order has been obtained by them.

Personal.—The New York *Electrical Review* says:—"Mr. A. K. Baylor, who for some years was prominently connected with the electric railway department of the General Electric Company, and later was manager of the British Thomson-Houston Company, of London, has established an export business in American electrical apparatus with New York offices in the Bowling Green Building, New York city. Mr. Baylor has also recently formed, at Manchester, England, the British Electric Car Company, Limited, which proposes to manufacture electric railway cars in the rough upon the designs and lines which have proved so successful in the United States, and to finish them in accordance with the demands of European purchasers and operators."

Trade Announcements.—The business of Mr. Isidor Frankenburg has been formed into a limited liability company, with a nominal capital of £250,000, one half of which is in 5 per cent. preference, and the other half in ordinary, all £10 shares. For 33 years Mr. Frankenburg has been an india-rubber and waterproof manufacturer, and more recently has also manufactured electric cables. It is not proposed to make an issue to the public, it being the intention of the vendor that the business shall remain in the hands of his family and employés. The first directors are Mr. Isidor Frankenburg and his sons, Mr. Merton and Mr. Ralph Frankenburg, and it is intended to appoint further directors from the chief employés of the firm. The consideration for the business is paid entirely in shares, and the vendor leaves the whole of the capital of the business in the concern.

Mr. Thomas S. Rice, M.I.Mech.E., of Aldermary House, 60, Watling Street, E.C., has been appointed London agent for the Rankine Patent Feed Water Filter Company, Limited, of Liverpool, whose specialities include their compound double filtration and other types of filters applicable for electrical installations. These filters are fitted and at work in a number of the electricity supply works throughout the United Kingdom and abroad.

The British Griffin Chilled Iron and Steel Company, Limited, have removed their offices from the offices of the New York Car Wheel Works at 18, St. Swithin's Lane, to the Cannon Street Buildings, 139, Cannon Street, and 20, Abchurch Lane, E.C.

Mr. Wm. Glenny Keagey, who has acted as secretary of the British Griffin Company since its organisation a year ago, to take over the business of the New York Car Wheel Works in chilled castings, railway and tramway wheels in England and the Colonies, has severed his connection with the English company, and continues the London offices of the New York Car Wheel Works at 18, St. Swithin's Lane, E.C.

Messrs. H. M. Salmony & Co., Limited, British representatives of E.A.G., late W. Lahmeyer & Co., of Frankfort a-M, inform us that a contract for generators and motor-dynamos for the Charing Cross and City station has been given to Messrs. Lahmeyer. The switchboard will be provided with Messrs. Lahmeyer's patent switching gears, which are arranged in such a manner that no high tension current is on the main board itself. By this arrangement, safety to human life is ensured. Even the instruments recording the high tension current are connected in such a way, that they can be handled with perfect safety, as no high tension current reaches them. Messrs. Salmony also have other important work on hand for Lahmeyer apparatus.

ELECTRIC LIGHT AND POWER NOTES.

Aberdare.—The D.C. has refused to assent to the electric lighting scheme of the Aberdare Electric Lighting Company, Limited.

Aberdeen.—The E.L. Committee of the T.C. has accepted the tender of the Johnson-Lundell Electric Traction Company, Limited, for a 420-KW. set, at £3,990, for the Dee Village station.

Armidale (N.S.W.).—At a Council meeting a letter was read from the Crompton Electric Company, owners of the Sandon water-power electric works, asking if the Council was prepared to give permission to allow them to erect poles in the streets of the municipality for the installation of the electric light to business places. The Council owns the local gas works, which it has worked at a profit, and the feeling amongst aldermen is that if the Crompton Company desire to instal electricity they should be prepared to purchase the gasworks. This is quite a novel view of the matter for a municipality to take.

Ashton-under-Lyne.—The Electricity Committee has appointed Mr. Appelbee, chief electrical engineer of the Cardiff Corporation, to a similar position at the Ashton electricity works. The Committee is about to greatly develop the electrical plant, and has increased the salary of the engineer to £350 per annum.

Barnsley.—The T.C. has decided to apply to the L.G.B. for leave to borrow £20,000 for extensions of the electric lighting plant.

Beckenham.—On November 22nd the new combined scheme of electric lighting and dust destruction, which has been carried out by the U.D.C., was inaugurated in the presence of Mr. T. C. Cole, J.P., the chairman, and members of the Council. The scheme has been carried out at a cost of about £40,000, under the direction of Mr. R. P. Wilson, and Mr. J. A. Angell, the Council's engineer. Mr. G. A. Flower was clerk of the works. A network of some 15 miles of low tension, and 14¼ miles of high tension cables has been laid. The Council has made an arrangement with the British Insulated Wire Company to work the scheme for five years. The Council will raise the whole of the capital required, and the contractors will pay the sinking fund and interest on the capital. The contractors, during the five years, will destroy the whole of the house refuse, and will receive the revenue from the sale of electrical energy during the period of the contract. At the end of five years the Council will take over the undertaking, without paying any premium or consideration beyond the initial contract price.

Blackpool.—The Electric Lighting and Tramways Committee of the T.C. has been made into two Committees, with all the former members on each.

Brighouse.—The electricity works of the Corporation having proved inadequate to meet the demand, Messrs. Lacey, Clirehugh & Sillar have prepared a scheme for the construction of new works, combined with a refuse destructor, at an estimated cost of over £20,000. This has been adopted by the Corporation.

Brighton.—The T.C. has passed the recommendations of the Lighting Committee, published in our issue of 15th inst., to the effect that consumers requiring supply during slack times may have a time switch installed to cut out their demand indicators at such times.

East Cowes.—The D.C. does not intend to oppose the application of the Edmundson Electricity Corporation for a prov. order for electric lighting in the district.

Festiniog.—A committee of the U.D.C. has been arranging for the supply of the outer portions of the district with electrical energy by Mr. Osborne Yale, the Council to furnish all plant, poles, wires, &c., while the central district is to be supplied direct by Mr. Yale's appliances.

Goole.—The U.D.C. has decided to apply to the B. of T. for a prov. order for electric lighting, chiefly for the sake of protecting the municipal gas works.

(c. H. V. James and Mills). Particulars will be found among our advertisements.

being entirely separate, and at least half a mile away from the scene of the fire.

Hove.—The Hove Electric Lighting Company has decided to reduce meter rents, and to reduce the price per unit supplied at 220 volts to 7d. and 4d., the charge for supply at 110 volts remaining at 8d. and 4d.

Leeds.—The Lighting Committee is about to lay mains extensions in 14 streets in the centre of the city, and in the Beeston, Hunslet, and New Leeds districts; also to build two transformer chambers in Roundhay Road and Vicar Lane. Various other roadways are to be opened for laying tramway feeders.

Lichfield.—The City Council has decided to apply to the B. of T. for an electric lighting prov. order.

Maidstone.—The L.G.B. has sanctioned the borrowing of £34,565 by the Maidstone T.C. for electric lighting purposes.

Mexborough.—An inquiry was held last week by Mr. F. H. Tulloch, L.G.B. inspector, into the application of the U.D.C. for leave to borrow £13,400 for electric lighting and £4,600 for a refuse destructor. Great interest was taken in the matter by the ratepayers, a large number of whom were present. There was little opposition.

Newark (Notts).—At a meeting of the T.C. on Monday last, the E.L. Committee recommended the Council to purchase certain sites for a total sum of £1,200; and that Mr. Vesey Brown should be instructed to prepare plans and specifications of electrical works. There were two schemes proposed. One of them would cost about £16,000, and it was estimated that the expenditure per annum, including repayment of capital, would be £2,115, and the income £2,000, leaving a deficiency of £115. On the other scheme, the proposed expenditure was £27,000, and this would produce an income of £4,115, leaving a balance in favour of the authority of £1,053. The motion was agreed to unanimously.

Nottingham.—The revenue from the Corporation electricity undertaking during the past year produced a gross profit of £9,073, the sales of current amounting to £18,222. In spite of the introduction of electricity, the gas undertaking produced a gross profit of £77,347, of which £24,000 went to the relief of rates. The electricity undertaking yielded £2,000 towards the reduction of the general district rate. Those who agree with us in objecting to the appropriation of large profits in this way, in place of reduction of charges, will no doubt be interested in this instance.

Omagh.—The U.D.C. has obtained a report on the utilisation of water-power for the supply of electricity. The report recommends the employment of a fall about three miles from the town, augmented by steam-power when the load exceeded the water-power available. An alternative scheme provides for a gas-driven station in the town.

Peterborough.—On Friday last the T.C. considered the appointment of two pupils of the electrical engineer at the electric light station. It was stated that the premiums to be paid were to go to the engineer, and the Corporation were to pay the salaries. The suggestion led to strong opposition, but eventually the report recommending the appointment of the pupils was carried.

Ryde.—The T.C. has sent back for further consideration a recommendation of the E.L. Committee to the effect that Messrs. Kincaid, Waller & Manville be authorised to obtain tenders for the purpose of carrying out the electric lighting scheme prepared by them.

Sandown.—A public meeting has passed a resolution by a large majority in favour of the proposal to use electricity for street lighting in the Council's district.

Selkirk.—At a recent special meeting of the Commissioners the draft agreement with Messrs. Crompton & Co., relating to the electric lighting of the burgh, was considered and approved of.

Stirling.—The Police Commission has resolved to apply for powers to borrow money for the purposes of wiring consumers' premises for electric lighting, and for acquiring and hiring-out motors, &c.

Thornhill.—The D.C. have under consideration offers from three companies to light the township with electricity. These companies are the West Yorkshire Electrical Syndicate, the Northern Counties Electricity Supply Company, and Messrs. Bennett & Ward-Thomas, of Manchester. The first two companies are about to apply to the Board of Trade for orders, and the application of the West Yorkshire Syndicate will be supported by a local deputation.

Transvaal.—During the sittings of the Concessions Commission at Pretoria the concession of the Rand Central Electric Power Company was inquired into. Mr. Lance appeared for the company, and stated that, it being an English company, the directors were all in London. The company instructed him to adhere to the terms of the concession. They claimed no exclusive rights, had never claimed the right to lay mains in Johannesburg, but were content to deliver the energy to the municipality at a point outside the town, to be conveyed through municipal mains. They would be satisfied if the concession were allowed to stand. If amended, they would like to be consulted as to the proposed amendment. Mr. Gorrison, general manager, who was examined, said there was a company formed on similar lines to theirs, called the General Electric Power Company. They only claimed the right to go over Government ground, and not private property, without the consent of owners. (Plans of company's workings were put in, also balance-sheets.) They had no Raad resolution, they were working under the Gold Law. The line as it stands had been approved by Government Commissioner. The scheme was not yet complete; they would extend the line as far as Krugersdorp. No objection was entered. The sitting was adjourned.—*African Review.*

Walton-on-Thames.—Messrs. Edmundson's Electricity Corporation have withdrawn their application for a prov. order for this district, in consequence of the threatened opposition of the U.D.C.

ELECTRIC TRACTION NOTES.

Austria.—A company is now in course of formation with a capital of £280,000 for the establishment of an electric railway between Vienna and Pressburg.

Belgium.—A project for joining Brussels and Antwerp by means of an electric railway is at present under the consideration of the Government. An underground station is to be built in the Place des Palais, Brussels (opposite the King's Palace), and on leaving the tunnel outside the city, the line will run nearly parallel with the line of the State railways to Antwerp, stopping in the Central station of the State railways administration. The length of the line will be about 25 miles.

Bexley and Erith.—The Bexley U.D.C. are applying for Parliamentary powers to lay down a system of electric tramways at Bexley, East Wickham and Crayford, and in the borough of Woolwich. The Council also apply for powers to widen various streets and to supply electric light and power along the tramway route, and to places both in and without their district.

Birkenhead and Wirral (Cheshire).—A scheme is under consideration by the General Purposes Committee for the construction of an electric tramway system to join the new Wallasey electric tramways, and to proceed through the north-west part of Wirral, connecting Leasowe, Meols, Hoylake, Little Calder, Frankby, Greasby, and Upton, joining the Birkenhead new electric tramways system near Bidston. Roughly, the scheme would mean the construction of a system in the form of an elongated oval, measuring about 5 miles on its longest axis, and requiring about 12 miles of track. This scheme would meet a long felt want, by providing ready communication between Leacombe and Birkenhead, and would much facilitate travelling between the places named and Liverpool. The construction would be carried out by a company formed for the purpose.

Brussels.—The administration of the tramcar service "Nord-Midi," in Brussels (5, Boulevard du Jardin Botanique), are open to receive tenders, to be considered at an early date, for replacing their present horse cars by an "accumulator" service. The itinerary is 1½ miles, all paved, and nearly in a straight line, practically level. From 24 to 30 passengers to be accommodated by each car.

Ceylon.—We read in the *Ceylon Standard* that the Legislative Council has resolved to appoint an expert to report on the proposal to use electrical traction on the Uda Pussellawa Railway.

Dartford.—The Dartford District Light Railways Order came before Sir Courtenay Boyle at the Board of Trade on 27th inst. The order was practically agreed to in 1897 by the Light Railway Commissioners, but subsequently a question arose regarding interference with a certain recreation ground. Sir Courtenay Boyle suggested that the parties meet in conference and try to arrange matters. The promoters' engineer suggested the construction of a light iron viaduct to carry the railway over the recreation ground.

Dewsbury.—Notice is given that all objections to the confirmation of the Light Railway Commissioners' order for the construction of electric trams in the Dewsbury district must be lodged with the Board of Trade on or before December 6th. The British Electric Traction Company have made an offer to the Dewsbury and Batley Tramways Company (steam traction) for the purchase of their undertaking, but, up to the present this has not been entertained.

Electrical Omnibuses in France.—Services of electrical omnibuses are, it is reported, about to be started between Clermont and Crevecœur and between Breteuil and Beauvais, in the French Department of Oise.

Folkestone.—The Corporation recently proposed to apply for a Tramway Bill for an undertaking to cost in the neighbourhood of £100,000, but a poll of ratepayers has reversed this decision.

France.—The construction of a tramway worked by mechanical traction between the Gare du Vaugneray and the borough of the same name, in the Department of the Rhône, is at present under consideration.

M. Joseph Monin, 91, Rue Miromesnil, Paris, is authorised to construct a narrow gauge electric railway for the transport of mineral products from Paimpol (Ile de Villaine) to the Gare de Mauron (Marbihan).

filters are fitted and at work in a number of the electricity supply works throughout the United Kingdom and abroad.

The British Griffin Chilled Iron and Steel Company, Limited, have removed their offices from the offices of the New York Car

Goole.—The U.D.C. has decided to apply to the B. of T. for a prov. order for electric lighting, chiefly for the sake of protecting the municipal gas works.

Italy.—The Mediterranean Railway Administration have under consideration the establishment of a line between Rome and Naples (190 miles) to be worked by electricity. It is calculated that the duration of the journey will be reduced from five to three hours.

A contract has been made between the town of Côme and the Société Helvois for the concession of the Côme electric tramway.

Kingston-on-Thames.—On Wednesday last week a meeting of ratepayers was held for the purpose of considering resolutions authorising the Corporation to apply for Parliamentary powers for a tramway scheme, and also to authorise opposition to the Bill promoted by the London United Tramways, Limited, so far as it affects the borough. The hall was filled to overflowing, and the proceedings were one long succession of disorderly interruptions. Councillor T. Lyne, chairman of the Tramway Committee, had to sit down half-way through his speech, but Mr. A. W. Homersham, who opposed the motion, was able to make one or two points. Dr. Finny, who was received with the singing of "He's a Jolly Good Fellow," supported the motion, and wound up by producing a telegram which he had received that afternoon, reading: "Refrain from meeting, and 500 preference debentures *sic* are dependable." This led to a scene of wild enthusiasm at first, and the Doctor was cheered to the echo, but when it became apparent that the telegram was not signed, the cheering changed to hissing. Mr. W. M. Wilkinson, a solicitor, then jumped upon the platform and denounced the telegram as a forgery. Ultimately the resolution was lost by a large majority, but one authorising the Corporation to oppose the company's Bill was passed, after which Councillor Lyne, on behalf of the Tramway Committee, demanded that a poll should be taken.

Leamington and Warwick.—The British Electric Traction Company has concluded an agreement with the shareholders of the Leamington and Warwick Tramways and Omnibus Company, Limited, for the purchase of their undertaking, and the Corporations of Leamington and Warwick have approved the overhead system. The existing tramway is a horse-worked line three miles in length. The capital of the company is £15,850, and there are 4 per cent. debentures amounting to £4,600. The working expenses (horse traction) have been 8·64d. per car mile. The B.E.T. Company is to buy out existing shareholders at par. The track will have to be dismantled, a new track laid and equipped, and an electric power station erected and fitted. The payment to the existing share and debenture holders will be about £21,000; the laying of the new track, equipment and power station will represent at the least a further £29,000. On this basis the new company will have to earn dividends on a capital of £50,000, as compared with the £21,000 share and debenture capital of the existing company.

Liverpool.—Alderman Petrie has been re-elected chairman of the Tramways Committee of the Liverpool City Council, and Alderman F. Smith, vice-chairman. When the cross-lines now in course of construction are completed, the Committee hope to run a service of cars right round the city as a "belt" service. The Committee have got rid of between 2,000 and 2,500 horses during the past 12 months, through using electric, instead of horse traction. They now hold about 1,100 horses, most of which will shortly be sold. The returns for five week's working from October 7th to November 10th show the following totals:—Receipts, £42,623 11s. 5d., as against £35,904 3s. 4½d. last year; passengers, 8,708,459, as against 6,542,847; mileage, 929,780, as against 761,159; vehicles, horse cars and 'buses, 75; electric cars, 221; total, 296, as against horse cars and 'buses, 250; electric cars, 49; total 299, in the corresponding period of 1899.

Two accidents in working the new electric car system at Liverpool are reported. In one case a car on the Green Lane route ran into a herd of cattle which had debouched upon the track at right angles, from a side lane. One beast was killed and others were badly injured. In the second case, a car descending the Everton Village incline, failed to slow sufficiently to avoid colliding with an ascending car. Both cars were damaged, but the passengers escaped without serious injury.

The Metropolitan Railway and Electric Traction.—The attention of the directors of the Metropolitan Railway Company has been drawn to a Parliamentary notice which has been advertised of a Bill to be deposited by the British Westinghouse Electric and Manufacturing Company, Limited, for the next session of Parliament, from which it appears that powers are to be sought by that company, in connection with the substitution of electrical for steam traction, on the systems of the Metropolitan and District Railway Companies. With the view of preventing any misunderstanding, the directors of the Metropolitan Railway Company announce that the notice referred to has been published without their consent and without any previous consultation with them upon the subject.

Middlesex.—The Middlesex C.C. have adopted the report of their Parly. Comtee., in which it was stated that they had given careful consideration to the resolution of the Ccil. as to the purchase of the tramway undertaking in the county, and had resolved that it was not desirable at present to promote a Bill or to insert the necessary Parly. Notice of a Bill for their purchase.

Manchester.—It was decided on 19th inst. at a joint meeting of the Electricity and Tramways Committees, to at once take steps to appoint an expert, whose duty it should be to see the whole tramway scheme carried through to a successful end as rapidly as possible. The present position of the tramways undertaking is stated by a Manchester paper as follows:—Everything that the Tramways Committee themselves can do is being done, under the direction of Mr. D. Boyle, the chairman, and with the enthusiastic co-operation of Dr. Bishop, the new chairman of the Electricity Committee. Five hundred men are engaged on the reconstruction of the permanent way, and this number will be doubled next spring, when it is hoped to reconstruct the straight track at the rate of two miles per week. Of the 430 cars ordered in January last, 190 are now under construction, and a large number will be ready for delivery in a month's time. As previously stated, the first routes to be opened will be Cheetham Hill Road, Bury New Road, and Rochdale Road. It is hoped that the energetic action on the part of the Tramways Committee will enable them to be in a position to take over the Stockport Road and the Hyde Road lines soon after the middle of next year. The Moss Side and Withington lines will follow, and afterwards the Ashton New Road, Ashton Old Road, Oldham Road, and other lines. Everything, however, depends upon the Electricity Committee. As Mr. J. M. M'Elroy, general manager, has pointed out in a report to his committee, the construction of a large electric tramway system, regardless of the source of supply, is like building a solar system and leaving out the sun. With the assistance of an expert, and with both Committees concerned working harmoniously and energetically together, it is hoped that, although the original dates for taking over certain portions of the system cannot be adhered to, the limit of time allowed under the agreement for completing the conversion will not be exceeded. On Saturday last the Committee visited London and interviewed five well-known experts. They also sent a deputation to Liverpool. It appears that preliminary arrangements for the appointment of an expert were made in London. It is stated that his duties will be as follows:—

(1) To exercise general supervision over the present station in Dickinson Street; (2) to supervise the completion of Bloom Street station; (3) to undertake the erection at once of the new large station in Stuart Street, Bradford; (4) to report upon the prospects of the Electricity Committee being able to supply the power for running the cars on the Cheetham Hill, Bury New Road and Rochdale Road routes, and devise means for so aiding the Dickinson Road plant that the routes can be dealt with satisfactorily; and (5) to devise, if called upon, the overhead and car electric equipment for the new tram system. Practically, the new expert will have supreme control of all the tramway, traction, and lighting arrangements of the electricity department until the present difficulties have been overcome.

Nottingham.—The city engineer, Mr. A. Brown, confidently hopes that the electric tramcars will be available for public traffic over the Sherwood-Great Market Place route—the first completed section of the electric tramways scheme for the city—in the course of the next few days. On Thursday in last week the Board of Trade inspection of the route was made by Mr. Trotter, and unlike the official trial on the previous Friday night everything passed off successfully.

Sheffield.—Electricity has now taken the place of horse traction on the Brightside route of the city tramways.

South Lancashire.—Notice has been given by the South Lancashire Tramways Company of their intention to apply to Parliament for powers to construct eight lines of tramways which will connect Ashton-in-Makerfield and Warrington, Worsley, Hulton, and Farnworth and Bolton and Darwen; also from Prescot through Huyton and Roby to join the Liverpool electric car system at Broadgreen; this extension will be in addition to the lines for which powers were obtained last session, for constructing an extensive system of electrical tramways in the districts of Earlestown, Leigh, Tyldesley and Eccles, having connection with the Manchester system. The lines for which powers have been obtained, and for which they are about to be sought, comprise 133 miles of electric track. The lines already sanctioned in the South Lancashire area comprise 88 miles of track, the St. Helens lines 22 miles, and the new lines for which powers are to be sought, 23 miles 5 furlongs.

Spain.—Senor D. Luis Rouviere, of Barcelona, is the author of a scheme for the construction of an electric railway from Lerida to the French frontier. The necessary electrical energy would be generated by means of the utilisation of water-power on the route.

TELEGRAPH AND TELEPHONE NOTES.

African Telegraphs.—The *Chronicle* Berlin correspondent states that the Estimates for 1901 contain an item of £10,000 towards the expense connected with the beginning of the telegraph line which will connect Dar Es Salam, in German East Africa, with Lake Tanganyika. This line will eventually join the Cape to Cairo wire. At present, however, it is only intended to push on with the line to Mpapua, a distance of about 270 miles from the coast.

Brighton Telephones.—A sub-committee of the Telephone Committee has been appointed to look out a suitable site for telephone offices, and to report.

The New Anglo-German Cable.—A dispatch from Berlin states that the *Post* learns from a well informed source that, owing to the unfavourable weather usually prevailing at this time of the year, the new Anglo-German telegraph cable cannot be laid before the spring. The work of manufacturing the cable, which has been entrusted to a German firm, is proceeding rapidly.

The Pacific Cable.—The *Sydney Daily Telegraph* for October 22nd stated:—"A message has been received from England by the Premier with reference to the Pacific cable. It is of a confidential nature, and, according to Sir William Lyne, of a satisfac-

there was a company formed on similar lines to theirs, called the General Electric Power Company. They only claimed the right to go over Government ground, and not private property, without the

struct a narrow gauge electric railway for the transport of mineral products from Paimpol (Ile de Villaine) to the Gare de Mauron (Marbihan).

tory character. A motion by Mr. Crick has been on the business paper of the Assembly for some time for the House to go into Committee to consider the expediency of bringing in a Bill 'to enable the Government of New South Wales to join with certain other Governments in the cost of construction and maintenance of a cable across the Pacific Ocean, and for purposes consequent upon and incidental to such object.' It is possible that the Postmaster-General will shortly be able to proceed with this Bill."

Russian Telephony.—The *Electrical World* of New York prints a dispatch from St. Petersburg which says that the telephone systems of the Russian cities, hitherto operated by the State, were to be sold at auction on November 20th. It was understood that the St. Petersburg municipal government would bid for the local franchise.

Sunderland Telephones.—The Highways Committee has been considering the question of acquiring and controlling the telephones of Sunderland municipally. It was decided to approach Mr. A. R. Bennett and ascertain what his charges would be for advising the Council on the matter.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
African—St. Louis (Senegal)-Bathurst	Aug. 25, 1900	
St. Louis (Senegal)-Teneriffe	Nov. 11, 1900	
Zanzibar-Mombassa	Sept. 29, 1900	
Zanzibar-Aden	Nov. 9, 1900	Nov. 26, 1900
South American—Pará-Maranham	March 1, 1900	
Paramaribo-Cayenne	Oct. 6, 1900	Nov. 21, 1900
Cayenne-Pinheiro	Nov. 26, 1900	
Barcelona - Guanta - Cumana - Portlamar-Carupano (Venezuela)	Nov. 1, 1900	
Falmouth-Bilbao	Nov. 19, 1900	
Havre-Waterville	Nov. 8, 1900	Nov. 23, 1900
Latakia-Cyprus	June 20, 1899	
New York-Cap Haitien	Nov. 26, 1900	
Landlines:—		
African—Majunga-Tananarive	Nov. 6, 1900	
South American—Communications with all offices of Colombia beyond Buenaventura	January 22, 1900	
Interior of Colombia landlines	Nov. 19, 1900	
Ecuador landlines	March 13, 1897	
Landlines west of Barquisineto and Coro	Nov. 1, 1900	
Barcelona (Venezuela)-Ciudad (Bolivar)	Nov. 1, 1900	
West Indian—Landlines to Baracoa, Guantago and Sagua de Tanamo	Nov. 12, 1900	
Landlines between Puerto Plata and San Domingo City	Nov. 20, 1900	
Dominican landlines	Nov. 21, 1900	Nov. 21, 1900
Chinese—Tientsin-Pekin	June 12, 1900	
Pekin-Kalgan	June 14, 1900	
Kalgan-Maimatchin	June 30, 1900	
Tientsin, *via* Shanghai	June 16, 1900	
Tientsin-Niuchwang	June 18, 1900	
All lines connecting Cochin China with Thuanan	Oct. 23, 1900	
Communication between Saigon and North Annam and Tonkin	Oct. 23, 1900	
Communication "*via* Hanekine" interrupted on Persian territory	Feb. 24, 1900	

Wireless Telegraphy.—A New York exchange says that the French War Department has decided to devote $80,000 to secret experiments with wireless telegraphy with a view to perfecting its campaign applications.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—December 22nd. The E.L. Committee wants tenders for storage batteries. See "Official Notices" to-day.

Ayr.—December 7th. The Tramways Committee wants tenders for overhead work, poles, brackets, section boxes, &c.; also underground work (feeders and other cables, conduits, trenching, &c.) for the electric tramways. See "Official Notices" to-day.

Bermondsey.—December 3rd. The Vestry invites tenders for 71 cast-iron arc lamp columns, arc and incandescent lamps, automatic switches and fittings. See "Official Notices" November 16th.

Bexhill.—December 10th. The U.D.C. wants tenders for water-tube boiler and pipework, and one 150-kw. steam dynamo. See "Official Notices" November 23rd.

Birkenhead.—December 4th. The Corporation wants tenders for switchboard and instruments for the tramways power station, Craven Street. See "Official Notices" November 23rd.

Blackpool.—December 17th. The Corporation wants tenders for the supply of arc lamp carbons and oils for one year. See "Official Notices" November 23rd.

Brighton.—December 6th. The Council invites tenders for points, crossings, sole-plates, manhole covers and gulley-grates, tie-bars, fish-bolts, &c., for the electric tramways. See "Official Notices" November 16th.

Brighton.—December 13th. The Council wants tenders for the construction of permanent way including bonding, &c.; paving all tramway tracks with wood, &c. See "Official Notices" November 16th.

Bristol.—December 20th. The Electrical Committee wants tenders for induced draught plant, steam and electric pumps, and water-softening plant. See "Official Notices" to-day.

Buxton.—December 6th. The U.D.C. wants tenders for wiring the Town Hall. See "Official Notices" to-day.

Copenhagen.—January 3rd, 1901. The Corporation invites tenders for three 530-kw. dynamos, switchboards, &c. See "Official Notices" November 23rd.

Harrogate.—December 25th. The Corporation wants tenders for two Lancashire boilers, with economiser and fittings. See "Official Notices" to-day.

Hendon.—December 31st. The U.D.C. wants tenders for Lancashire boilers, stokers, pumps and economiser; two 150-kw. steam dynamos, motor transformer, &c.; condensing plant, crane, switchboard work, battery, mains, meters, and workshop equipment for electricity works. See "Official Notices" November 16th.

Leeds.—December 10th. The Markets Committee invite tenders for the purchase of belt-driven electric lighting plant, now at the Kirkgate Market, comprising one pair of Robey's 30-b.h.p. gas engines; one pair of dynamos, made by Mr. Harding Churton, each 180 amps., 110 volts, 850 revolutions, including belting, water tanks, lamps, switchboard, and fittings. For further particulars apply at the City Engineer's office, Municipal Buildings, Leeds.

Leigh.—December 17th. The Electricity and Tramway Committee wants tenders for mains, and for 1,000 220-volt incandescent lamps. See two "Official Notices" to-day.

Manchester.—December 1st. Tenders are wanted for twelve workmen's electric cars. See "Official Notices" November 23rd.

Newington (Southwark).—December 3rd. The Electric Light Committee of the Southwark borough, wants tenders for the erection of back E.M.F. cells at the electric light station. See "Official Notices" November 23rd.

North-Eastern Railway.—December 10th. The directors want tenders for the undermentioned articles during the six months ending June 30th, 1901:—(1) Telegraph apparatus; (2) Telegraph wire and line stores. Forms of tender on application to Mr. Graves, Telegraph Department, York.

Paraguay.—January 15th. The municipality of Asomption, Paraguay, is inviting tenders for the electric lighting of the town. Bond, £600.

Partick.—December 4th. The Commissioners want tenders for electricity meters, demand indicators, and fuses. See "Official Notices" November 23rd.

Portsmouth.—December 7th. The Corporation wants tenders for permanent way construction and underground feeders for the electric tramways; also for overhead electrical equipment., See two "Official Notices" November 23rd.

Rathmines.—January 11th. The District Council wants tenders for Lancashire boiler, 300-kw. steam dynamo, condensing apparatus and pipework, switchboard extension, mains, and public lighting (incandescent). See "Official Notices" to-day.

Stavanger.—January 2nd. Tenders are invited by the Stavanger Corporation for the establishment of electrical communication or transmission of power from the Altesrig Waterfalls to Stavanger, a distance of about 39 kilometres, in accordance with the plans of a civil engineer named Schoien. Tenders must be received by January 2nd, 1901. Further information may be obtained on application direct to Mr. E. Berentsen, British Vice-Consul, Stavanger.

Swindon.—December 24th. The Corporation wants tenders for the supply of three high speed triple-expansion steam dynamos, balancer, and motor-generator for electricity works. See "Official Notices" to-day.

Tyne.—November 30th. The Tyne Improvement Commissioners want tenders for the electric lighting of the Northumberland and Albert Edward Docks, including everything but the generating plant. See "Official Notices" November 23rd.

West Ham.—November 30th. The Council wants tenders for two 25-b.h.p. oil engines, two 15-kw. dynamos, battery and switchboard for the Dagenham Hospital, Essex. See "Official Notices" November 23rd.

CLOSED.

Belfast.—The Gas and Electric Committee have placed a contract for cast-iron pipes with Messrs. R. Laidlaw & Sons. The tenders for plant for the electric station have been referred to the engineer for report.

Bristol.—The Electrical Committee has accepted the tender of the E.P.S. Company for batteries at Temple Back; also that of Messrs. Higginbottom & Mannock for a travelling crane at Avonbank, theirs being the lowest submitted.

Glasgow.—Messrs. Lowdon Bros. have secured the contract for the wiring and other appliances required in connection with the electric lighting of the Grand Avenue at the Glasgow Exhibition.

Hastings.—The Gilbert Arc Lamp Company, Limited, Chingford, have received a contract for an extension of open type arc lighting for Hastings Corporation.

possible. The present position of the tramways undertaking is stated by a Manchester paper as follows:—Everything that the Tramways Committee themselves can do is being done, under the

The Pacific Cable.—The *Sydney Daily Telegraph* for October 22nd stated:—"A message has been received from England by the Premier with reference to the Pacific cable. It is of a confidential nature, and, according to Sir William Lyne, of a satisfac-

Devonport.—The following tenders have been recommended by the Electricity Works Committee for acceptance by the Council. Mr. Charles Furness is the borough electrical engineer:—

Section A.—Buildings exclusive of chimney and flues (9 tenders), Mr. A. H. Cole	£5,433
Section D.—2 vertical engines (22 tenders), Part 1, S. Z. de Ferranti	3,200
Section D.—Part 2, 2 generators, balancer (22 tenders), battery, booster and motor, Electric Construction Company, (22 tenders)	3,659
Section D.—Part 3, switchboard, Electric Construction Company, (subject to certain deductions) (11 tenders)	2,922
Section E.—Storage battery (7 tenders), Ashmore, Benson Pease & Co.	2,600
Section F.—10-ton crane (7 tenders), Higginbottom & Mannock	326

The following tenders were recommended for acceptance:—

Babcock & Wilcox, two boilers and mountings	£1,950
Bennis & Co., stokers and automatic dampers	535
Green & Son, economiser	440
Glenfield & Kennedy, tanks and meter	274
Mather & Platt, grease filter	70
Carruthers & Co., valve chest	60

London.—The London County Council on Tuesday had under consideration the following tenders received for the supply of arc lamps for the lighting of the Victoria Embankment and Westminster Bridges:—

Gilbert Arc Lamp Company	£2,209 18 6
" " " " (alternative) (accepted)	2,515 0 0
New Century Arc Light Company	2,330 0 0
Crompton & Co.	2,598 0 0
Oliver & Co.	2,910 11 6
" " " (alternative)	2,676 2 0
Veritys, Limited	2,959 12 0
General Electric Company	3,3.0 0 0

In a report on these tenders the Highways Committee mentioned that the Gilbert Arc Lamp Company had submitted two modified proposals in addition to its tender in accordance with the specification. Those proposals were for the use of (1) split globes at a cost of 30s. each extra, for the parapet lamps; and (2) specially long carbons at an extra cost of 50s. each, for the kerb lamps. The engineer stated that split globes were not specified as they were not in general use; but that the adoption of them would facilitate the trimming and cleaning of the lamps, and that the extra cost would be about £105. As regarded the second proposal, the engineer stated that probably a considerable saving would be effected in the cost of trimming, although some loss might arise from breakage through the use of such long carbons, and that the extra cost if the proposal were adopted would be about £200. The engineer was of opinion that the advantages to be gained by the adoption of both proposals would justify the increased expenditure; and on the recommendation of the committee the Council accepted that company's tender for the sum of £2,515.

FORTHCOMING EVENTS.

Friday, November 30th.—At 8 p.m. Institution of Junior Engineers. Inaugural Meeting of 20th session, Westminster Palace Hotel, Sir Lowthian Bell, Bart., F.R.S., delivers the Presidential Address.

At 8 p.m.—The Faradian Club. Lecture by Prof. C. A. Carus-Wilson on "Swiss Polyphase Railways."

Saturday, December 1st.—At 2.0 p.m. and 3.0 p.m. The Institution of Electrical Engineers (Students' Section). Visit to Generating Station of Waterloo and City Railway.

The Society of Model Engineers. Annual conversazione, Memorial Hall, Farringdon Street, E.C.:—

Lectures and Demonstrations.—A lecture by Mr. Macfarlane Gray, M.I.Mech.E., on "Power"; Mr. Olaf. F. Bloch will give a chemical demonstration on "Explosives"; a lecture by Mr. E. L. Pearce, entitled "Induction Coil Experiments"; a practical demonstration of glass blowing by Mr. T. Bolas, F.I.C.

Tuesday, December 4th.—At 8 p.m. Society of Arts, Cantor Lectures. "Electric Oscillations and Electric Waves," by Prof. J. A. Fleming, M.A., DSc., F.R.S. Four lectures. Lecture II.—"Electric Resonance." The free period of vibration of an electrical system—Tuned or resonant circuits.—Damping of oscillations—Good and bad radiating circuits—Electric resonance as a phenomenon in optics.

Wednesday, December 5th.—At 7.30 p.m. Institution of Electrical Engineers. Meeting of Students' Section. Papers to be read:—"Bipolar Machines," by Mr. R. L. Pearson; "Multipolar Machines at the Paris Exhibition," by Mr. C. T. Stephenson.

At 8 p.m.—Society of Arts. Third Ordinary Meeting. "Road Traction," by Prof. H. S. Hele-Shaw, LL.D., F.R.S. Sir Alexander Binnie will preside.

Friday, December 7th.—At 4.0 p.m. Institution of Electrical Engineers. Students' visit to the Electrical Standards Laboratory of the Board of Trade, 8, Richmond Terrace, Whitehall.

Thursday, December 6th.—At 8 p.m. Röntgen Society. Meeting at 20, Hanover Square. Mr. J. Mackenzie Davidson, M.B., will give an exhibition and description of his Stereoscopic Fluoroscope and a New Rotary Mercury Break.

January 3rd.—Mr. A. W. Isenthal: A paper.

Arrangements are being made for an evening devoted to X ray work during the late military operations; an Exhibition evening (smoking, &c.), as last session; and a "Discussion" evening, subject: "X Ray Therapeutics;" and Mr. J. Cadett promises a paper on "Some X Ray Improvements."

At 8 p.m.—Civil and Mechanical Engineers' Society Meeting, paper on "Valve Gears and Valve Diagrams," by Prof. R. H. Smith, M.I.E.E., &c.

Saturday, December 8th.—At 3 p.m. Visit of Institution of Junior Engineers to the London United Tramways Company's electric generating station at High Road, Chiswick.

Institution of Electrical Engineers. Students' visit to the Manchester Square station of the Metropolitan Electric Supply Company.

Tuesday, December 11th.—Institution of Electrical Engineers (Manchester Section). Meeting at Owens College, Manchester.

Wednesday, December 12th.—At 8 p.m. Institution of Electrical Engineers, (Glasgow Section). Meeting at the Institution of Engineers and Shipbuilders, Bath Street.

Thursday, December 13th.—At 8 p.m. Institution of Electrical Engineers. Meeting at the Institution of Civil Engineers, Great George Street, S.W.

Friday, December 14th.—At 8 p.m. Institution of Mechanical Engineers, Storey's Gate, S.W. "Power Gas and Large Gas Engines for Central Stations," by H. A. Humphrey, Northwich.

NOTES.

What's in a Name?—A curious confusion arose at the meeting of the Institution of Electrical Engineers on November 22nd, with regard to the recording telephone invented by Valdemar Poulsen. This marvellous instrument (which we fully described in our issue of October 12th) is rightly called the "telegraphone"; but Mr. Gavey gave it as the "microphonograph," and was solemnly corrected by Mr. Hammer, who said it was the "telephonograph"! Prof. Thompson, with his customary regard for accuracy of nomenclature, gave the correct appellation. Mr. Dane Sinclair had another version—the "telophonograph." As a matter of fact, the telephonograph, which also was described in our issue of October 12th, but briefly, is the invention of Mr. E. O. Kumberg, associated with Mr. Higgins, of the Exchange Telegraph Company, and consists of a real combination of a phonograph and telephone. We are unable to call to mind any instance in which the electrical Press of London has "pooh-poohed" the telegraphone, as stated by Mr. Dane Sinclair; we certainly never did so. Will Mr. Sinclair kindly give details, when he next has occasion to criticise our contemporaries?

"A Dangerous Thing."—Our contemporary of the jealous complexion is given to passing on the contents of the technical electrical journals sour comments which are not always evidence of superior knowledge. For instance, we were some time ago gravely corrected for speaking of boosters driven by shunt-wound motors—because, said Mentor, the shunt-wound motor is as much part of the booster as the dynamo! Has our amiable critic never seen a booster driven by a steam engine or by a turbine? The kind of criticism, however, more favoured by, and more within the capacity of, our revered contemporary, is verbal criticism; and a supposed error in our issue of 16th inst. is seized upon with a triumphant flourish—"Of course *I'* is meant, but the misprint makes terrible nonsense of the article." The article in question is that of M. Guarini and Lieut. Poncelet on "Wireless Telegraphy with Repeaters," and the authors, having explained that they had reduced the time required for the mechanical operation of the relays to an extremely small value, remarked that the time constant of the induction coil causes delay, through prolonging the depression of the sending key—that is, the time *t*, as printed. *Ne sutor ultra crepidam*; our Mentor would do well to confine his attention to orthography, and to let technical matters alone.

Bristol.—December 20th. The Electrical Committee wants tenders for induced draught plant, steam and electric pumps, and water-softening plant. See "Official Notices" to-day.

Hastings.—The Gilbert Arc Lamp Company, Limited, Chingford, have received a contract for an extension of open type arc lighting for Hastings Corporation.

Machine Tools.—The *Daily Chronicle* says that the Technical Instruction Committee of the Sheffield Corporation recently made a special grant of £1,200 to the University College, Sheffield, for the purpose of acquiring modern machine tools. Prof. Ripper, principal of the school, has established a machinery department in which his pupils will be able to study the most modern types of machine tools in the world's markets. The proposal to introduce tools of foreign manufacture has met with opposition on the part of local manufacturers, but the department considered that it is of the greatest importance that the young mechanics of Sheffield should have an opportunity of becoming acquainted with the most approved methods of machine shop practice. In the equipment of the new department, accordingly, nationality has not been taken into consideration, but a careful selection has been made of the best tools, both European and American. As regards the nationality of the various tools Great Britain is decidedly in the shade, Germany and the United States having secured the majority of the orders. It is quite possible that those dissenting local manufacturers might learn a useful wrinkle or two by taking a course in the new machinery department.

Return of Electrical Engineers Volunteers.—We understand that the group of gentlemen who organised the send-off dinner at the Prince's Restaurant in February are arranging for (as far as may be possible) the same hosts to give a welcome-home dinner in the same restaurant. The date, as at present fixed, will be Monday, December 17th, and any alteration (if any be necessary) will be announced. Mr. Henry Edmunds, of 2, Queen Anne's Gate, is hon. treasurer, and will be glad to receive the names of gentlemen who wish to act as hosts in place of any of the original hosts who may be unable to attend. The subscription of each host, covering the cost of his own dinner, inclusive of wine, will be two guineas.

The E.E.R.E. Volunteers propose to entertain the South African Detachment to a dinner and smoking concert at the Trocadero, on Saturday, December 15th, Mr. H. A. Barrett, Sapper, is acting as hon. sec., and communications should be addressed to 13, Victoria Street, S.W.

American Automobile Shows.—With the close of one automobile show in New York another began at the Grand Central Palace. There elaborate preparations for a 10-day show, opening on Wednesday evening, November 14th, had been made. The Palace Show was not a duplicate of the Garden Show. It afforded room for many vehicles that were on view for the first time.

The *Electrical World* makes the following editorial comments on the claims of the electro-mobile :—

That electrics are well to the front must be the firm opinion, we think, of every one who has visited the Madison Garden show. In ease of control by man or woman, in cleanliness, in absence of odour, heat, vapour, and jar, they are unapproachable; and while all the other types have undeniable merits, it is clear that the electrics are in the competition to stay, sure of public approval and patronage, particularly in the cities. While we prefer a substantial vehicle ourselves, we must confess to a strong feeling in favour of the light new "piano box" electric automobiles so much in evidence at this show, with lessened weight of battery and a marked diminution in price. For these a large range of customers awaits, to whom with increasing facilities for charge, a new pleasure opens up denied to them under the old *régime* of the horse.

Manufacturers report themselves as pleased with the result, although they took action wisely to check the growing tendency to increase the number of automobile shows. They would soon bankrupt themselves if they did not put a sharp limit on that form of expense. There are other ways of reaching the customer, and the vital question is how to create and fill the demand. From personal investigation we can say that a large patronage is to come from a portion of the community very much in evidence at the show, but not yet reached, namely, the people of moderate means who have never felt able to "keep their carriage" in the cities. So far, automobiles have been built for fashionables and industrials, but in stage lines and in low-cost vehicles a field without limit is opening up. We venture to believe that more automobiles can be sold in this country, for example, to private users, on the instalment plan, than pianos, and the number of pianos thus disposed of runs into more hundreds of thousands than any automobile manufacturer has yet set down in his calculations.

Birkbeck Institution.—The annual distribution of prizes and certificates to students attending this well-known Institution took place last Wednesday evening. Sheriff Sir W. P. Treloar presided, and Lord Kelvin performed the ceremony and addressed the meeting.

American Impressions.—Mr. R. W. Allen, of Queen's Engineering Works, Bedford, has just returned from a 60 days' tour in the States, and in a letter to the *Times* of yesterday he has written his impressions, from which we make the following extracts :—"I visited most of the principal electric construction companies, engine builders, tool makers, locomotive works, steel works, and electric power plants, and in every case and everywhere I saw how far and away advanced they are over us in methods of construction, design and magnitude. One electric power station in New York alone has 66,000 H.P., and their success is due to the extraordinary care and attention which are given to every minute detail, not one point being missed . . . . Unless we radically alter and improve our system generally, we shall be left far behind . . . . It is not only in engineering we are behind; it is the same story in many branches of industry. . . . . If the British employer would only admit that he is beaten, endeavour to reorganise and make a fresh start, I believe we might yet hold our own and regain much of the lost foreign trade."

An Electrical Engineer's Slander Case.—Lord Stormonth Darling, in the Court of Session on Tuesday, approved of issues for the trial of an action in which Francis Teague, burgh electrical engineer, Paisley, sues Dr. William Russell, 52, High Street, Paisley, for £1,000 damages for alleged slander. The defender is a member of Paisley Town Council, and one of the members of the Electric Lighting Committee. The pursuer avers that at a meeting of the Electric Lighting Committee on September 24th, 1899, the defender used language which represented that the pursuer was an agent for the sale of electrical lamps, and obtained a royalty thereon, and that with a view to earning the royalty, he refused to discharge his duty as a servant of the Town Council, and declined to connect an intending consumer's electric lighting installation unless the consumer agreed to purchase the lamps in which the pursuer was interested. The statement is said to have been a malicious invention. The defender denies the slander, and pleads privilege.

Reply to "H. J. S."—No harm whatever is done by drilling a small hole in the porous pot of a Leclanché cell to allow the solution to saturate the interior more quickly. The sole object of the pot is to hold the depolarising agents in position against the carbon element. For ringing an electric bell, we have found a plain carbon and zinc in sal-ammoniac solution entirely satisfactory in every way without any depolariser.

Lectures.—On Saturday evening Mr. W. A. Chamen, the city electrical engineer, gave a popular lecture in the Corporation Galleries on "The Municipal Electric Service," Bailie W. Maclay, chairman of the electricity department, presiding. Mr. Chamen gave a history of the electric supply in Glasgow from its commencement, and showed a large number of lantern slides.

Sir William Preece lectured at the Owens College on Monday evening on "Intercommunication by means of Electricity."

On 28th inst., at the City of London College Science Society, Mr. W. J. Tennant read a paper on "Wrinkles in Patent Law and Practice."

On Wednesday night Mr. S. A. Stammwitz lectured on "Wireless Telegraphy" (with experiments) at the Shoreditch Wesleyan Mission, Hackney Road.

Personal.—Mr. Appelbee, chief electrical engineer of the Cardiff Corporation electric lighting station, has been appointed to a similar position by the Ashton Electricity Committee.

Mr. Wm. Sillery has been appointed resident electrical engineer at Wrexham.

Electrical Treatment of Lead Poisoning.—The decision of the Governors of the North Staffordshire Infirmary to introduce into their institution an electrical equipment for the treatment of lead poisoning cases has taken definite shape. Subscriptions have been got together for installing apparatus for electric baths, X ray apparatus, &c.; certain rooms have now been allocated, and authority given for the work to be done.

Friday, December 7th.—At 4.0 p.m. Institution of Electrical Engineers. Students' visit to the Electrical Standards Laboratory of the Board of Trade, 8, Richmond Terrace, Whitehall.

sending key—that is, the time *i*, as printed. *Ne sutor ultra crepidam*; our Mentor would do well to confine his attention to orthography, and to let technical matters alone.

The Cheltenham Accident.—On the 21st inst. the inquest was held on the body of Richard Edwards, electrical jointer, in the employ of the Cheltenham Corporation, who met with his death at the Manchester Street sub-station of the electricity works in that town on 13th inst. The Home Office was represented by Mr. Maitland and Mr. Pendock. The evidence was to the effect that deceased was engaged in testing transformers at the sub-station. He was last seen by a fellow workman in the act of inserting a fuse in one of these transformers—which was, of course, "dead," but no sooner had his companion turned his back than he heard a cry, and, turning round, saw the deceased in a sitting posture on a "live" transformer, which stood close to where Edwards was working. This latter transformer, it should be explained, was covered by an india-rubber mat—a complete protection against contact with the "live" metal—but in his fall the deceased appears to have disarranged the mat and exposed a portion of the transformer, and it is supposed that some part of his body came in contact with the current, which was sufficient to cause instant death, the pressure being 2,000 volts. A *post-mortem* examination was made by Mr. Powell, surgeon, who found the organs of the body healthy, and who gave it as his opinion that death was due to paralysis of the heart, the result of a shock such as might be occasioned by electric current.—The jury returned a verdict in accordance with the medical evidence. They added a recommendation to the effect that the electrical engineer and the Corporation would consider whether some better and more efficient steps might be taken to protect machinery of this kind, so as to prevent a similar accident in the future.—The Mayor (Alderman Norman) remarked that anything which could be done in this direction should be done.

Prof. Fleming's Cantor Lectures.—The first of the course of Cantor Lectures on "Electrical Oscillations and Electric Waves" was delivered by Prof. J. A. Fleming on Monday night. Numerous experiments were shown.

Fatality.—The explosion at the Metropolitan Electric Supply Company's Sardinia Street station, to which we referred last week, caused the death of a stoker. The evidence at the inquest showed that a seam of a boiler tube had given way, and deceased was severely scalded. He was admitted to King's College Hospital able to stand and to talk, but numerous burns were found on the body, and he died the next day from shock. The inquest on 22nd inst. stood adjourned. Mr. Reginald Todd said he thought that there was an original defect in the weld of the tube, which had become weak to bursting point by natural deterioration. The jury returned a verdict of "Accidental death," and exonerated the makers of the boiler from all blame.

Students' Section of the Institution of Electrical Engineers.—A special visit for student members who are not attending any of the Technical Colleges in London will take place at 4.0 p.m., on Friday, December 7th, to the Electrical Standards Laboratory of the Board of Trade, 8, Richmond Terrace, Whitehall. Mr. Ll. R. Lester is the hon. sec. of the Students' Section.

The Institution of Electrical Engineers.—The Council of the Institution of Electrical Engineers has arranged, with the kind permission of the Institution of Mechanical Engineers, that if the discussion on Mr. Langdon's paper read last night had to be adjourned, a second extra meeting should be held, also at the Institution of Mechanical Engineers, on Thursday next, December 6th.

New Journal.—We are informed that a new monthly journal will shortly make its appearance. It will be known as the *Electro-Chemist and Metallurgist*, and the office of the paper will be that of Messrs. Sherard Cowper-Coles & Co., Limited, 82, Victoria Street, S.W.

Wireless Telegraphy.—Receiving and transmitting instruments on Marconi's system will be installed at the Essex Manufacturers' Exhibition, in aid of the Essex disabled soldiers, to be held at the Shire Hall, Chelmsford, on December 12th, 13th and 14th.

NEW COMPANIES REGISTERED.

Claud Hamilton (Aberdeen), Limited (4,662).—This company was registered at Edinburgh on November 5th, with a capital of £5,000 in £1 shares, to acquire and carry on the business of electrical engineers and contractors carried on at Aberdeen and Inverness by P. C. Middleton & Co., Limited. The subscribers (each with one share) are:—Claud Hamilton, 247, St. Vincent Street, Glasgow, electrical engineer; Alex. Ferguson, 236, W. George Street, Glasgow, chartered accountant; G. Watson, 53, Bothwell Street, Glasgow, naval architect; David Alexander, 247, St. Vincent Street, Glasgow, electrical engineer; R. Clement Boyd, 82, W. Regent Street, Glasgow, writer; James Y. Collie, 25, Union Street, Aberdeen, advocate; and P. C. Middleton, Elstree Forest Road, Aberdeen, electrical engineer. The number of directors is not to be less than two nor more than four; the first are Claud Hamilton, J. Y. Collie, Alex. Ferguson and P. C. Middleton; qualification, 150 shares; remuneration as fixed by the company.

Imperial Electric Supplies Company, Limited (67,681).—This company was registered on November 5th, with a capital of £50,000 in £1 shares, to adopt an agreement with G. Bargate, G. S. Hertslet, H. W. Knott, E. P. Harvey and J. L. Bell, and to carry on the business of electricians, electrical and general engineers, manufacturers of electrical and other apparatus, tool makers, and manufacturers of motors, switches, transformers, sockets, circuit breakers, meters, lamps, &c. The first subscribers (each with one share) are:—G. Bargate, Constitutional Club, W., gentleman; G. S. Hertslet, 22, Linacre Road, N.W., gentleman; R. I. Browne, 17, St. Olaf's Road, Fulham, S.W., retired; E. Bird, 5, Gray's Inn Square, W.C., solicitor; H. Edmonds, 20, Beechfield Road, Catford, accountant; H. G. Powell, Hillside, Highgate Road, N.W., accountant; and W. T. Wills, 127, Lumley Buildings, S.W., clerk. The number of directors is not to be less than two nor more than seven; the first are G. Bargate, G. S. Hertslet, H. W. Knott, and E. P. Harvey; qualification, £1,000; remuneration as fixed by the company.

William Douglas, Limited (4,664).—This company was registered in Edinburgh on November 7th, with a capital of £1,000 in £1 shares, to acquire the business carried under the style of William Douglas, 11, Picardy Place, Edinburgh, and to carry on the business of telephone and electrical engineers in all its branches and departments. The first subscribers (each with one share) are:—W. Douglas, 11, Picardy Place, Edinburgh, electrician; W. Macintosh, 11, Picardy Place, Edinburgh, electrician; Mrs. Isabella Douglas, 20, Leopold Place, Edinburgh; Miss Ella Douglas, 20, Leopold Place, Edinburgh; James Douglas, Abbey Street, Edinburgh, clerk; James McCall, Abbey Street, Edinburgh, engineer; and A. Wright Gilchrist, 9, Alexander Street, Partick, gentleman. Registered without articles of association.

General Electric Company of Ireland, Limited (2,509).—This company was registered in Dublin on November 15th, with a capital of £2,000 in £1 shares, to construct, purchase, lease, or otherwise acquire any tramway or tramways in the Counties of Dublin and Wicklow, or in the vicinity thereof, and to carry on the business of electricians, electrical and general engineers, &c. The first subscribers (each with one share) are:—Vere Ward Brown, Balnagowan, Rathmines, merchant; John Chambré, Mesgril House, Dublin, merchant; W. M. L. Joynt, 66, Northumberland Road, Dublin, B.L.; W. R. McTaggart, Deepwell, Blackrock, Co. Dublin, cycle manufacturer; L. R. Oswald Sealy, Rathclaren, Bray, Co. Wicklow, gentleman; Harry Maginn, 101, Phibsboro' Road, Dublin, clerk; and R. M. Hennesey, 31, Foster Terrace, Ballybough Road, Dublin, clerk. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification, £50; remuneration as fixed by the company. Registered office, 22, Nassau Street, Dublin.

Perfect Light Company, Limited (67,776).—This company was registered on November 13th, with a capital of £25,000 in £1 shares, to adopt an agreement with the Scott-Snell-Phillips Syndicate, Limited, and M. Lachman, and to carry on the business of electricians, manufacturers of electrical and lighting apparatus and lamps of all kinds, &c. The first subscribers (each with one share) are:—A. I. Ellis, 26, Tytherton Road, N., merchant; T. Thomas, 65, Moorgate Street, E.C., tailor; M. Lachman, 22, Palace Court, West, engineer; C. S. Snell, Culver Park, Saltash, Cornwall, engineer; S. A. Howell, 16, Paternoster Row, E.C., solicitor; A. C. Snell, 6, Winsham Street, Clapham, S.W., artist; and F. A. Snell, 57, Leathwaite Road, S.W., engineer. The number of directors is not to be less than three nor more than five. The first are C. S. Snell, C. W. Phillips and M. Lachman.

French Electric Lighting Boards, Limited (67,810).—This company was registered on November 15th, with a capital of £4,000 in £1 shares, to acquire from E. P. Sachs the benefit of certain existing inventions relating to electric lighting boards for luminous advertisements or otherwise. The first subscribers (each with one share) are:—J. Feil, 53, Klondike Road, Balham, S.W., secretary; C. Broomfield, Dashwood House, E.C., gentleman; S. C. Whittle, 40, Carlingford Road, West Green, N., accountant; F. E. Mardon, Dashwood House, E.C., clerk; W. E. Bennett, Dashwood House, E.C., clerk; B. Blewitt, 22, Grove Road, Wanstead, articled clerk; and W. Brider, 43, Appach Road, Brixton, S.W., clerk. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, £10; remuneration, £100 each per annum (£50 extra for the chairman) and a share in the profits. Registered office, 7, Pall Mall, S.W.

Sir W. P. Treloar presided, and Lord Kelvin performed the ceremony and addressed the meeting.

&c.; certain rooms have now been allocated, and authority given for the work to be done.

Ross Electric Light and Power Company, Limited (67,825).—This company was registered on Nov. 16th, with a capital of £8,000 in £1 shares, to carry on in the Urban District of Ross, Hereford, the business of an electric light and power company in all its branches. The first subscribers are:—J. Mackay, Reay House, Bodenham Road, Hereford, contractor, with 100 shares; C. Allmond, Mitre Hotel, Hereford, licensed victualler, with 100 shares; J. Parker, 14, Nelson Street, Hereford, civil engineer, with 100 shares; A. Johnson, The Highlands, Hereford, civil engineer, with 50 shares; E. C. Gurney, 12, High Town, Hereford, grocer, with 50 shares; H. Southall, The Craig, Ross, gentleman, with 10 shares; and F. W. Wintle, Bank Offices, Ross, accountant, with 10 shares. The number of directors is not to be less than three nor more than seven. The first are J. Mackay, J.P. (chairman), E. C. Gurney, C. Allmond, and A. Johnson, J.P.; qualification, £50. Registered office, 8, St. Mary's Street, Ross, Hereford.

Whittaker Bros., Limited (67,858).—This company was registered on November 20th, with a capital of £7,000 in £1 shares, to adopt an agreement with J. H. Whittaker and B. W. Whittaker to carry on at Derby, Kidderminster, and elsewhere the business of an electric light and power company (including telegraphy and telephony), to construct, maintain, and deal with cables, wires, lines, accumulators, lamps, works, &c., and to carry on the business of electrical and other motor car manufacturers, electrical and general engineers, launch builders, &c. The first subscribers (each with one share) are:—W. W. Jenkins, 65, High Street, Dudley, manager; T. G. Marsh, 206, Wolverhampton Street, Dudley, merchant; J. H. Wythes, 59, High Street, Dudley, decorator and plumber; F. E. Clark, Brooke Street, Dudley, brick manufacturer; W. Builder, Greenfield Avenue, Stourbridge, traveller; Mrs. M. L. Jenkins, Brooke Street, Dudley; and F. J. Marsh, 206, Wolverhampton Street, Dudley, agent. The number of directors is not to be less than three nor more than seven; the first are W. W. Jenkins (chairman), J. H. Whittaker, B. W. F. Whittaker, and T. G. Marsh; qualification, £200.

Lyndhurst Electric Lighting and Traction Company, Limited (67,854).—This company was registered on November 20th, with a capital of £500 in £1 shares (250 founders'), to construct or acquire, equip and word railways and tramways, to supply electricity for light, heat, power, and other purposes, and to carry on the business of electricians, electrical and general engineers, promoters, financiers, &c. The first subscribers (each with one share) are:—R. G. Fudge, 38, Beecroft Road, Brockley, secretary; G. Elkin, 27, Mill Hill Road, Acton, clerk; J. T. Down, 137, Clapham Road, S.W., clerk; J. F. Moreno, 20, Dalrymple Road, S.E., gentleman; E. Atkinson, Rosebank, Jowey, Cornwall, gentleman; T. Williams, 21, Suffolk Street, Pall Mall, S.W., hotel proprietor; and C. J. Wharton, Palace Chambers, Westminster, consulting engineer. Table "A" mainly applies. Registered office, Palace Chambers, Bridge Street, Westminster, S.W.

Rawlings Brothers, Limited (67,908).—This company was registered on November 24th, with a capital of £100,000 in £1 shares, to carry on the business of electrical and general engineers, builders, decorators, manufacturers of, and dealers in, electrical accessories and instruments, wire, cable, and line manufacturers, suppliers of electricity for the purposes of light, heat and motive power or otherwise, bicycle, tricycle, and velocipede manufacturers, motor car and carriage builders, machinists, fitters, millwrights, founders, wire drawers, tube makers, tool manufacturers, saddlers, platers, japanners, &c. The first subscribers (each with one share) are:—J. J. Rawlings, 82, Gloucester Road, South Kensington, engineer; W. R. Rawlings, 82, Gloucester Road, South Kensington, electrical engineer; R. T. Smith, 61, Carey Street, W.C., solicitor; H. S. Rawlings, 141, High Road, Chiswick, electrical engineer; F. Rawlings, Carr Villa, Gartmoor Gardens, Wimbledon Park, S.W., engineer; G. W. Rogers, 29, Southdown Road, Wimbledon, S.W., manager; and C. Rawlings, 58, Tranquil Vale, Blackheath, S.E., electrical engineer. The first directors are J. J. Rawlings, W. R. Rawlings, and R. T. Smith; qualification, £2,000.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Typewriting Telegraph Corporation, Limited (66,332).—This company's annual return was filed on October 24th, when 56,651 shares were taken up out of a nominal capital of £100,000 in £1 shares. 10s. per share has been called up on 19,662 and 1s. per share on 7,138 shares. £10,910 0s. 6d. has been paid, including £908 15s. prepaid. £186 12s. 6d. remains in arrears. £29,851 is considered as paid on 29,851 shares.

Windermere and District Electricity Supply Company, Limited (41,461).—This company's annual return was filed on September 25th, when 5,000 preference and 2,663 ordinary shares were taken up out of a nominal capital of £50,000 in £1 shares (5,000 preference). £5 per share has been called up on 3,040 preference and 1,497 ordinary, and 10s. per share on each of 231 ordinary shares, resulting in the receipt of £22,800 10s. £14,475 is considered as paid on 1,960 preference and 935 ordinary shares.

Mather & Platt, Limited (60,387).—This company's annual return was filed on October 24th, when 32,505 preference and 40,000 ordinary shares were taken up out of a nominal capital of £775,000 in 37,500 preference and 40,000 ordinary shares of £10 each. £10 per share has been called up on 21,705 preference and 2,500 ordinary shares, resulting in the receipt of £242,050. 10,800 preference and 37,500 ordinary shares are considered as fully paid.

SUPPLY STATION ACCOUNTS.

Blackpool Corporation Electricity Accounts.
Private supply, public lighting and traction.

The accounts of the Blackpool Corporation form an imposing volume of statistics relating to that famous northern watering place, and not least encouraging is the section dealing with electrical matters. Although the capital expenditure is proceeding less rapidly, the increases in output, in connections and in load are most substantial last year compared with the preceding financial period. When dealing with the accounts for 1898, we mentioned that the extensions in hand in March of that year were estimated to cost £40,000, and further extensions proposed might amount to a similar sum. The position attained is indicated by the following figures:—

GENERAL STATEMENT.

	1898.	1899.	Increase.
Total capital expenditure ...	£102,002	**£117,544**	£15,542
Number of units sold	870,184	**1,148,564**	278,380
Number of lamps connected ...	60,200	**78,000**	17,800
Maximum load in KW.	950	**1,300**	350
Gross revenue	£14,284	**£18,498**	£4,214
Gross expenditure...	£7,162	**£10,535**	£3,373
Gross profit	£7,122	**£7,963**	£841
Average price per unit sold ...	3·91d.	**3·56d.**	−·35d.

Over 1,000,100 units were sold, distributed as follows:—

Year.	1898.	1899
Private ...	523,412 at 8d., 5d., 2½d., and 2d. per unit.	726,860 at 8d., 7d., and 2d. per unit.
Public ...	164,922 at 8d. and 2d. per unit.	193,053 at 8d., 7d., and 2d. per unit.
Tramways...	181,850 at 2d. per unit.	228,651 at 2d. per unit.

The public lighting now represents 200 arc lamps (an increase of 54), and 264 incandescent lamps, while private consumers number 900. The total units generated reached 1,427,607 units. The length of mains is about 60 miles. The revenue account shows an increase of nearly £3,000 in the item for sale of energy, but the price per unit has fallen to just over 3½d., a reduction of ¼d. We suppose that consumers are now beginning to realise the utility of the demand indicator method of charging.

REVENUE STATEMENT.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy	£14,165	3·91d.	**£17,055**	3·56d.	−·35d.
Meter rents, &c.	...	...	...	...	...
Attending and repairs public lamps, carbons, interest and sinking fund on capital invested in street lamps, and profit on sales of lamps, &c.	...	...	**1,372**	·29d.	+·29d.
Other receipts	119	·03d.	**71**	·01d.	−·02d.
Gross revenue ...	£14,284	3·94d.	**£18,498**	3·86d.	−·08d.

In 1898 the costs fell by ·22d. compared with 1897. Owing to increases in "coal" and "repairs," the total cost has now risen by half the amount of the previous reduction. These items are certainly liable to increase in a station at work for some years and subject to the market fluctuations, which are being seriously felt throughout the country. As a result, works costs now stand just over 1¾d., and total costs at 2½d., satisfactory figures still. Mr. Quin has kept management expenses down, as will be seen in the summary.

COST OF PRODUCTION.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit	Increase.
Coal	£2,011	·55d.	£3,353	**·70d.**	+·15d.
Oil, waste, water and engine room stores.	788	·22d.	1,101	**·23d.**	+·01d.
Salaries and wages incurred in generation and in distribution.	1,614	·45d.	2,086	**·44d.**	−·01d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	1,092	·30d.	1,961	**·41d.**	+·11d.
Works costs	£5,505	1·52d.	£8,501	**1·78d.**	+·26d.

on December 12th, 13th and 14th.

Rent, rates and taxes ..	339	·09d.	478	·10d.	+·01d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	928	·26d.	974	·20d.	−·06d.
General establishment charges, stationery and printing, law charges and insurance	365	·10d.	542	·11d.	+·01d.
Other expenses	25	·01d.	40	·01d.	·00
Total costs ...	£7,162	1·98d.	£10,535	2·20d.	+·22d.

The financial charges in 1898 amounted to £4,545; these now absorb £6,787, equivalent to 1·42d. per unit sold, or an increase of £2,242, which is not covered by £841 larger gross profit, and the net profit, therefore, falls to £1,176, which has been placed to the credit of the local rate. A separate suspense account, totalling £14,039 for replacement of rubber insulated cable, has been liquidated as regards £9,470 by sums transferred from the general district rate, leaving £4,569 to be met within the next three years.

PROFIT STATEMENT.

	1898.	1899.		
Interest on loans	£2,605	£6,787	=	1·42d. p.u.
Sinking fund for repayments ..	1,940			
Net profit carried forward ..	2,577	...		
" " " to credit of rates	...	1,176	=	·246d. p.u.
Gross profit	£7,122	£7,963		

CITY NOTES.

British Westinghouse Electric and Manufacturing Company.

THE first annual meeting of this company was held on Friday last at Cannon Street Hotel. The report, which was submitted for approval, read as follows:—

The directors have pleasure in presenting their first annual report and balance-sheet for the period from July 10th, 1899, to July 31st, 1900. In addition to the orders and contracts taken over from the vendors, amounting to £279,000, orders have been received and contracts have been entered into since the incorporation of the company amounting to £550,000, thus bearing out the expectation expressed in the prospectus as to the development of the business. The net profit for the period under review, exclusive of the amount guaranteed by the vendors, is £10,777 7s. 7d., after providing for expenses of management, directors' fees, and all other charges, which is considered satisfactory, considering that the works at Trafford Park are still in course of construction. Out of this profit, supplemented by the guarantee, the directors distributed an interim dividend on the 6 per cent. preference shares in May last, amounting to £7,551 2s, calculated on the amounts paid up to January 31st, and now recommend the payment of a final dividend for the six months ending July 31st, amounting to £15,000, making 6 per cent. thereon for the whole period. The directors are pleased to report that the works at Trafford Park, Manchester, are making good progress, the agreement for the purchase of the land having been concluded, the plans for the entire works having been prepared by Mr. Thomas Rodd, of Pittsburg, U.S.A., from information and drawings supplied by the American Westinghouse Electric and Manufacturing Company under their agreement, and the principal contracts for the construction work having been placed. The requisite connections between the works and the principal railways have also been completed. In view of the large staff which will necessarily be required in connection with the works, a number of young English engineers have been sent to serve an apprenticeship in the works of the American Company at Pittsburg. By this method of forming the staff the directors believe that the principles of manufacture, which have been so successfully worked out in the United States, will be reproduced in the works at Manchester. Arrangements are being made to provide suitable dwellings for the operatives to be employed in the works, in which the men and their families will be well housed at reasonable rates with great advantage to the company. Technical and commercial managers have also been appointed, and are making themselves familiar with the approved methods adopted at the works at Pittsburg, which, as is well known, are equipped with the most modern plant and appliances, and where about 7,000 men are employed. The directors intend to establish branch offices in the more important manufacturing centres, and they have recently opened an office in Manchester, at Haworth Buildings, No. 5, Cross Street. In July this company took part in the Electric Traction Exhibition at the Agricultural Hall, Islington, and at the close of the Exhibition the car and track shown by the company were purchased by the London County Council for their experimental work at Camberwell. Pursuant to the provisions of the special resolution passed and confirmed in August, 1899, empowering the directors to appoint any qualified person an additional director, the board have to report that they have appointed Mr. Lukach and Mr. Kobbé to be directors of the company. The appointments do not require confirmation by this meeting. Under the Articles of Association no directors retire from office at this meeting. The board appointed Messrs. Delotte, Dever, Griffiths & Co., the first auditors of the company, and they will be proposed for re-election. At the conclusion of the ordinary general meeting an extraordinary meeting will be held, for the purpose of making a slight alteration in one of the Articles of Association. This is pursuant to a promise given to the Stock Exchange when the special settlement and quotation were granted for the preference shares.

The Hon. R. CLERE PARSONS, M.I.C.E., presided in the absence of the chairman (Mr. C. W. Benson), who had been ill for some months. In moving the adoption of the report, he said that Mr. Westinghouse was in America, and he was at present going through the plans and specifications for the equipment of the Manchester factory. Their sales for the financial year amounted to £550,000, which was an eminently satisfactory turnover, more particularly as in the prospectus they stated that the turnover during the previous year was £256,000. They had considerably more than doubled the turnover. In October last they made sales to the amount of £32,550, and up to the present date for November they amounted to £31,890, so that the position was being maintained. That was merely trading with machinery procured from the American Company, but when the Manchester works were completed they would look forward to the trade being very much larger. They had also absolutely in view, and hoped to secure within the next very few days, another £40,000, and they were preparing tenders further for sales which they had every reason to expect they would secure, for £104,000. Although the company was handicapped by obtaining the machinery from America, with freights and other charges against them, they were already doing a very large business. Some of them might have said that, with the great turnover, why was it that the net profit was only £10,777? The position of the company was a peculiar one. Although the American company had been trading here for some years, and had made a considerable position for itself, this concern was a very different one. They were expending at a very rapid rate; their company would have a staff of from 3,000 to 5,000 men. They had to gradually put together a staff to manage the concern; they had engaged highly paid officials, and had to carefully train them. They could not prepare to furnish their works with an efficient staff for nothing. Various delays had occurred in the completion of the works. Those delays had occurred through no fault of theirs. The works would not be completed in the time that was anticipated. The board had had the matter carefully in view, and had approached the American Company, who were guarantors, to make up the deficit on the 6 per cent. preference shares, and had asked them whether they would continue their guarantee until the works were completed. They had received a telegram saying that the matter was under most careful consideration. Various reports had reached the directors' ears to the effect that they had abandoned the construction of the works at Manchester. They had prepared plans showing the properties secured and the general arrangement of the different departments from which they would gather that the rumour was not true. The plans showed land upon which they had their eye for extension purposes, also land upon which they might build dwellings for their operatives (negotiations on this point are proceeding with the Trafford Park Dwellings Company). It was just as important to house operatives properly, economically, &c., as to introduce labour-saving machinery in works. The cottages would be lighted electrically, heated by means of gas from a centre, and supplied with water. In these ways they hoped to be able to attract a high-class labour, and reap the fruits in connection with the shops' turnout. As to staff, they had selected in this country a number of young engineers who had received the highest possible training in technical colleges, and they had gone to America, to the Pittsburg works, where they were undergoing a careful training in every branch of electrical engineering. They wished to make the concern an English company, and to employ, as far as possible, English engineers; but at the same time it was necessary, at all events at first, to obtain a certain number of American engineers, who had been carefully trained for years back, to start the business properly in England, and to run it until they had obtained properly educated English engineers who were up to the newest practice in American shops. The company had been started principally with English capital (two-thirds). In order to keep the English trade up to the mark it was necessary not to sit down and say that English manufacturers are good enough, but to import the best, if they are better, and to raise the standard of English manufacture up to the highest possible point. That was the whole object of this company—that is its whole and sole object. He proceeded to show the scale upon which the works at Manchester were being started. There were shops for the purpose of turning out every class of electrical machinery, one for steam engines and for gas engines of large size. The large shop will cover eight acres. The heavy machinery will be constructed on the ground floor of the works and the smaller machinery will be constructed on the floors above. The large machine shop is laid out in such a way that the machinery, as it comes from the iron foundry, the steel foundry, and the brass foundry, will be passed into the machine shops and come out the finished article on the other side. Coal supply would come from the Wigan district along the canal. There will be steam generating plant, and also a gas engine generating station side by side, and they would be in the actual position to ascertain what are the relative advantages of their large gas engines and steam engines, and to make any tests required. During the past year at the Agricultural Hall, Islington, they showed their complete system of electric tramway traction which would be suitable for the streets of London—not for the centre of London, but for the streets especially to the south of the river, where there are over 100 miles of tramway now run by horses. Before long they expected to be in a position to submit a complete proposal for the electrification of the lines on the south side of the river. In regard to the electrification of the Metropolitan underground railways, they had been considering this important matter for some months past. It was a complicated matter, and it occurred to them that in order to assist the railway companies various requirements in the shape of Parliamentary powers were absolutely necessary. Within the last two months the companies had invited leading manufacturers of electrical machinery to submit schemes for carrying out that great work. The directors of this company found that in order to submit as complete a proposal to those companies as possible, it was absolutely necessary to apply to Parliament for powers for doing certain things in connection with the running of those railways. Those powers which they have asked for consist in this—that they should present a proposal to supply the entire outfit of electrical machinery, rolling stock, &c., of those companies at a given figure; that the payment for this work would be either in the shape of Lloyd's bonds, which bonds carry a first lien upon a company's property. These bonds would be issued to the contracting parties on the certificate of the engineers of the railways, and would be negotiated by this company in any way they might think fit. Another proposal which they intended to submit, and for which they had asked Parliament to sanction powers, was to lease the sites for the generating stations, for which those companies had secured Parliamentary powers; to erect on those

sites the necessary generating stations; to lay the necessary conductors to the lines in question; to supply the rolling stock, and all that was necessary for carrying on the traffic; that they should receive from those companies something in the shape of a guarantee upon the receipts of those companies; and this would be, practically, in the form of a contract with those companies, not interfering in any way with the preference, debenture, or any other shareholders. Before presenting this application to Parliament, they took the opportunity to mention the matter to the chairman of the Metropolitan District Railway, and communicated with the chairman of the Metropolitan Railway; but, unfortunately, he was ill. Their whole and sole object in presenting this application to Parliament was with the view of being in a position, if those companies thought fit to entrust the company with the contract for the electrification of these railways, to carry out that contract without hindrance and without delay. Their proposals and action had been entirely straightforward. It was not with a view to hamper the companies in any way; it was merely to be prepared when the time came, and the Westinghouse proposal was the one that was thought to be most advantageous. Possibly, it might not be so; and then, naturally, the application to Parliament would be inoperative. With regard to the expenditure which is necessary upon the works at Trafford Park, an issue of 25,000 £5 preference shares will shortly be made, and although they were fully underwritten, the board would have much pleasure in doing their utmost to secure the allotment of shares to any existing preference shareholder.

Mr. Sheriff Joseph Lawrence seconded the motion.

Shareholders asked for an approximate date for the completion of the works, and also how the Metropolitan railways contract could be carried out if the works were delayed.

The Chairman replied that they were certainly behind hand with the works. The reason was, that they were anxious to place the contract for the steel works and other portions with English firms. Many hundreds of tons of steel were already delivered. The contract was enormous, amounting to about 12,000 tons of steel for the principals. The rest of the work would proceed very rapidly, and "possibly by the end of next year we shall be in a fair way to commence work, but I do not think much before that." All the machinery that they would require for the Metropolitan railways would be manufactured in America.

The resolution was carried unanimously.

The thanks of the meeting were given to the Executive Committee, the auditors re-elected, and the chairman thanked in the usual way.

Southern Electrical Installation and Wiring Company.

The annual meeting of this company was held last week at Hastings, Captain Colville presiding. The report stated that the installation business of the company, as distinct from the free wiring department, might be considered satisfactory, when increased cost of labour and material is taken into account. It was difficult to transact free wiring business during the first nine months' working, but definite progress is now being made. The balance on the revenue account amounted to £390. Interest on the preference capital absorbed £126. £264 remained, out of which the board recommended that 5 per cent. to September 30th be paid. The report was adopted. In future there will be only one managing director instead of two, and one less director than hitherto, thus reducing the expenditure.

Prospectuses.

During the course of last week from time to time copies reached our hands of a so-called "Private and Confidential" Prospectus, bearing the date "Wednesday, the day of November" (*sic*); we have reason to believe that these have been scattered broadcast throughout the country.

The prospectus is accompanied by a large illustrated sheet of Press cuttings, with the title "The British Electric Street Tramways, Limited," in large letters across the front page; the illustrations represent work done by other companies, such as the British Electric Street Tramways, Limited, no doubt would like to do—the Central London Railway, for instance; Blackpool tramways, as they appeared *before* the conduit system was abandoned; Bradford Corporation trams, &c. The views include an impracticable "grand culvert system," with a tiny tram rail open conduit—the culvert being built under the tramway to accommodate pipes, wires, &c.! The cuttings are gushing eulogies of electric traction, extracted from the daily Press and similar sources. We cull the following weighty opinion:—"What a funny place England is!" said a little 10-year old American girl to her mother the other day. "Why, they actually have horses in their street cars!"

The prospectus itself is similarly embellished with extracts from the *Daily Mail*, the *Echo*, &c. The new concern is entitled

"The British Electric Street Tramways, Limited.
Construction and Maintenance Company (Parent)."

The sting is in the tail.

The nominal capital is £300,000, divided into 30,000 shares of £10 each, of which one-third is for working capital. Every 10 shares subscribed carry the right to apply for one £10 share in "The Founders' Syndicate, Limited." The latter is to have a capital of £60,000, in 6,000 shares of £10 each. Its object is to form new companies and promote Bills in Parliament for new railway and tramway undertakings, which the former company will have the first option of building and constructing. The Founders' Syndicate might appropriately be called the mother-in-law of the "parent" company.

An imposing list of first subscribers is given, headed by Mr. Hiram Maxim. The advisory electrical engineers are Messrs. Preece and Cardew. Amongst the directors are Mr. Thos. Parker, "electrical engineer, Metropolitan Underground Railway," &c., and Messrs. Gordon Hunter and H. G. Thomas, directors of the Electric Tramways Construction and Maintenance Company, Limited.

The company is formed to construct and work lines of electric railways and tramways, to take over and electrically equip old tramways and sell them to new companies, and so on. For these purposes the company will acquire the business which has recently been commenced, in connection with the construction of electric motors, accumulators, and other apparatus, under the superintendence of Mr. E. T. Parker, and known as the Electric Street Car Manufacturing Syndicate, Limited, near Wolverhampton. Much is made of the success of the concern of Messrs. Thomas Parker, Limited, of which Mr. Thomas Parker was formerly managing director; we are informed, however, that Thos. Parker, Limited, has nothing whatever to do with the British Electric Street Tramways Company, Limited, and has no interest whatever in its promotion. The overhead system to be acquired by the company is said to have so many advantages "that it only requires to be understood to be widely adopted." No details are given, except that "the wires are 'safety' wires," and "instantly become 'dead' wires in falling or in breakage." It is a good plan to put them up so that they don't fall. "The grand culvert system," to which we have already alluded, and "wireless trams," in which "the rail drives the car," *i.e.*, inside pegs, connected by hidden wires, touch a wire suspended under the car, *à la* surface contact, are also displayed in large type.

Certain agreements which are referred to in the prospectus—viz., (1) between Mr. Holroyd Smith and the vendor company (the Electric Tramways Construction and Maintenance Company, Limited); (2) between the latter company and the Electric Street Car Manufacturing Syndicate, Limited; (3) between Thos. Parker and the vendor company; and (4) between the vendor company and the British Electric Street Tramways, Limited, are printed at length on the backs of the application forms for shares in the British Electric Street Tramways and the Founders' Syndicate.

The first mentioned is dated February 14th, 1900, in the prospectus, but appears as February 14th, 1899, in the reprint. It provides that the Electric Tramways Construction and Maintenance Company shall purchase from Mr. Holroyd Smith, for the sum of £55,000 in shares, and subject to the appointment of the vendor consulting engineer to the company at a commission of 5 per cent on the cost of works carried out, certain patents and models specified in schedules which appear to have been renumbered and attached to the agreement which we have numbered (4). Three of these patents were taken out in 1893-4, five in 1899, two in 1900 (March and July; these appear to have been taken out after the agreement was signed); others, dated 1886, 1893 and 1895, are included, with the qualification that they "have, or may have expired." The models are:—Model of conduit as first used at Blackpool; model of conduit as now used at Blackpool (*sic*); models of switch-box for closed conduit, controlling switch, &c., samples of clamps, conductors, &c., photographs and drawings.

Agreement No. 2, dated October 6th, 1900, provides that the Electric Tramways Construction and Maintenance Company, Ltd., shall purchase from the Electric Street Car Manufacturing Syndicate, Limited, the business and goodwill of the latter company, the patents, &c., referred to in the first agreement and other patents &c., owned by the latter company, two acres of land and the buildings (works) thereon, and other eight acres apparently not built on. The purchase price is £24,000, of which £10,000 is to be in cash, and the remainder in shares in a company to be formed by the purchasers. The business was to be taken over at once, and worked by the purchaser company, which, however, was not bound to spend more than £300 on it up to December 31st next. Unless the purchase money is paid in full by February 15th next, the vendor may resume possession of the works.

Agreement No. 3, dated October 6th, 1900, sets forth that Thos Parker, senior, agrees to act as consulting engineer to the Electric Tramways Construction and Maintenance Company for three years, at a remuneration of £500 per annum, and one-tenth of the dividends or bonus paid to the shareholders.

Finally, Agreement No. 4 provides for the purchase by the British Electric Street Tramways, Limited, from the Electric Tramways Construction and Maintenance Company, Limited, of the contracts made in agreements Nos. 1 and 2, the sole benefit in London and Middlesex and half the benefits elsewhere of contracts entered into by the vendor company, for the consideration of 20,000 fully-paid £10 shares in the capital of the purchaser company. The same agreement provides for the formation of the Founders' Syndicate, Limited, with a capital of £60,000; these shares are to be purchased by the vendor company at a premium of 50 per cent., if so desired by the holders within one month of the date of allotment, and are thus artificially at a premium. The purchase of the business is to be completed on or before February 15th, 1901.

The Electric Street Car Manufacturing Syndicate, Limited, was registered on December 3rd, 1897, with an authorised capital of £25,000, and has therefore existed for nearly three years. The Electric Tramways Construction and Maintenance Company, Limited, was registered on December 8th, 1886, with a capital of £250,000, of which, according to Garcke's Manual, £55,507 has been issued—only 507 shares, however, having been paid up to the extent of £1 per share.

We have set the above facts before our readers to enable them to form a just estimate of the new flotation. It will not be difficult The value of the patents—some of which, by the way, never got

look forward to the trade being very much larger. They had also

companies had secured Parliamentary powers; to erect on those

beyond the provisional protection stage, at which they were dropped—together with that of the business and works of the Electric Street Car Manufacturing Syndicate, Limited (which has been working for less than three years, with a capital issued of £17,230) is to be set against £200,000.

When such an astounding proposition can be put before the public, how can the electrical industry flourish? We can only hope that not 200,000 pence will be subscribed towards this preposterous demand.

The list of applications closed on Wednesday in an issue of £400,000 4½ per cent. first debenture stock in the Brisbane Electric Tramways Investment Company, Limited. The share capital is £750,000. The proceeds of the issue will go to pay off the existing debentures and other debts and liabilities of the Brisbane Tramways Company, Limited, and in the construction and equipment of certain extensions. The present length of the lines is upwards of 33 miles of single track and the extensions represent an additional 12½ miles.

The gross receipts and mileage run of the existing lines have been as follows:—

	Receipts.	Miles run.	Receipts per mile.
1896 (horse traction)	£26,600 ..	803,400 ..	8d.
1897 (partly electric traction) ..	34,000 ..	866,200 ..	9½d.
1898 (partly electric traction) ..	52,700 ..	1,297,700 ..	9¾d.
1899 (wholly electric traction) ..	75,100 ..	1,756,400 ..	10¼d.
Six months to June 30th, 1900 ..	46,664 ..	1,096,000 ..	10½d.

Western Telegraph Company, Limited.—An extraordinary general meeting was held on Monday at the offices, Winchester House, when the resolution passed at the meeting on the 30th ult. for altering a clause in the articles, was unanimously confirmed.

Stock Exchange Notices.—The Committee has been asked to allow the following securities to be quoted in the Official List:—City of London Electric Lighting Company, Limited.—Provisional certificates for £200,000 4½ per cent. second debenture stock.

Cape Electric Tramways.—Holders of share warrants to bearer are entitled, on or before 5th prox., to subscribe, at 30s. per share, for their proportion of the new issue of 40,000 £1 ordinary shares. The time for subscription to holders resident in South Africa is extended to January 1st, 1901.

Eastern Extension Telegraph Company.—An extraordinary general meeting of this company was held at Winchester House on Thursday, last week, Sir John Wolfe Barry presiding. The resolution which was passed at the meeting held on 7th inst., altering certain articles of association, was unanimously confirmed.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending November 24th, 1900, were £162; corresponding period last year, £159; increase, £3. Total to date, £19,575; corresponding period last year, £19,575.

The Bristol Tramways and Carriage Company.—The receipts for the week ending November 23rd, 1900, were £2,708 1s. 6d.; corresponding period last year, £2,650 5s. 9d.; increase, £58 12s. 9d.

The Central London Railway.—The receipts for the week ending November 24th, 1900, were £5,755; previous week, £5,406; increase, £349. Total receipts to date (17 weeks), £87,921. Miles open, 6.

The City and South London Railway Company.—The receipts for the week ending November 25th, 1900, were £1,849; corresponding week last year, £1,035; increase, £814. Total to date, £33,957; corresponding period last year, £20,509; increase, £13,448. Miles open, 1900, 4¼; 1899, 3¼.

The Cork Electric Tramways and Lighting Company.—The receipts for the week ending November 22nd, 1900, were £324 11s. 10d.; corresponding week last year, £356 0s. 9d.; decrease, £31 8s. 11d. Total to date, £19,319 13s. 11d.; corresponding period last year, £17,857 6s. 1d.; increase, £1,462 7s. 10d.

The Dover Corporation Tramways.—The receipts for the week ending November 24th, 1900, were £162 12s. 2½d.; corresponding week last year, £158 4s. 0d.; increase, £4 8s. 2½d. Total to date, £9,769 15s. 10d.; corresponding period last year, £9,308 3s. 11d.; increase, £454 11s. 11d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,977; 1899, 4,791. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending November 23rd, 1900, were as follows:—D. U. T. Co., horse cars, £22 12s. 6d.; ditto, electric cars, £3,127 19s. 2d.; D. S. D. Co., electric cars, £684 10s. 10d.; total, £3,835 2s. 6d; corresponding week last year—D. U. T. Co., horse cars, £169 19s. 0d.; ditto, electric cars, £2,726 14s. 10d.; D. S. D. Co., electric cars, £674 9s. 2d.; total, £3,571 8s. 0d.; increase, £263 19s. 6d.; aggregate to date, £99,073 9s. 2d.; aggregate to date last year, £88,768 12s. 10d.; increase, £10,304 16s. 4d. The mileage worked is 44 miles electrically, 1 mile by horses, as against 36 miles electrically, 8 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending November 25th, 1900, were £1,525; corresponding week last year, £1,477; increase, £48. Total from July 1st, 1900, £35,074; ditto corresponding period last year, £34,276; increase, £708. Miles open, 6·57 chains.

STOCKS AND SHARES.

Wednesday Evening.

Business in the electrical sections is again becoming active, and investors are pinning their faith to the supply companies' shares with more and more confidence every week. A large trade is being done in the Preference shares, while the demand for Debentures, of which we have written several times lately, shows no sign of abate ment. It cannot be said that the market has benefitted much by external influences, because the condition of the Czar's health has thrown a check over the investment markets generally. Money, too, is inclined to be dearer now that the Bank of England has the market in its own hand, so that the healthy strength displayed by the electricity supply department is due to purely intrinsic reasons.

We are able to announce that arrangements are now nearly complete for the emission of a fresh Preference issue by the Edmundson's Electricity Corporation. The shares will bear interest at the rate of 6 per cent. per annum, and will probably be offered at £5 5s. each, *pro rata* to existing shareholders. We may remark that new issues in the market are frequently the signal for a fall to take place in the price of the current shares. Edmundson's have not yet receded. Those who get the offer of the coming Preferences should embrace it without delay. The privileged ones who declined their right to apply for new Chelseas at 6 may now see these shares standing at 6¼, while the many who thought that £5 2s. 6d. was too dear for new Charing Cross Preference are watching with envy the shares at their present price of £5 12s. 6d.

City of Londons have come gamely to the front this week after the period of deflection that followed so quickly upon the heels of that little boom in the shares. Buyers of the Ordinary have been abundant, and the Preference shares are 5s. better. Beyond this there is little change in the official prices, but buyers now find that they have to pay the top figures in the majority of cases, instead of effecting their purchases at the middle. As regards the Provincial descriptions, Bournemouth and Poole Ordinary are 13, the Preference 10½, while Oxford Electrics are 6 for the £5 shares, and Folkestone Ordinary, 5¾. Hove Electric—that excellent little company—boasts a quotation of 8 for its £5 shares, fully paid.

Telegraph stocks are dull, under the lead of the Eastern securities. Eastern Ordinary has fallen another 3 points, making 8 per cent. in the fortnight. It appears that the seller to whom we alluded last week has a large amount of what the Stock Exchange euphoniously calls "dead stock," *i.e.*, stock which has to be realised for a deceased person's executors. The block is being absorbed by degrees, but meanwhile it drags down the price. Eastern Extensions are also being liquidated for the same account, and both classes of shares are 5s. lower, the Debenture stock also shedding a point. West African 5 per cent. Debentures, on the other hand, are better by reason of the attention now being devoted to "jungle" companies. If the West African mining market in the Stock Exchange really means business, the Telegraph Company should be considerably advantaged thereby.

In the American telegraph group, the Anglo stocks are rather duller in consequence of the great storm that has raged round New York this week, which has, it is feared, damaged the Anglo Company's landlines. Directs are unaltered, nor is there any fluctuation in Submarine Cables Trust.

We may safely take it for granted that at least 75 per cent. of our readers holding shares in electrical companies have received a prospectus of the British Electric Street Tramways, Limited. Whoever drew up that document deserves undying gratitude for his contribution to the amusing literature of the day. The public are asked to subscribe £300,000 to a venture which is to take over a small business near Wolverhampton, together with various inventions and patents, as to whose value no word whatever of official estimate is given. For these "valuable" assets the vendors ask the paltry sum of £200,000 in cash or shares. The prospectus is accompanied by a sort of supplement containing various photographs of electric trams and an incorrect sketch of a train on the Central London Railway. While we yield to none in our belief that an immense future lies before electric traction, it is difficult to imagine that there can be anybody simple enough to apply for shares in such a company as the one whose prospectus lies before us.

Turning to the electric railway market, a further decline has been noted in City and South London Stock. The attempt of the company to raise more money by an issue of £10 shares at 5½ has demoralised the quotation, and dealers in the market shake their heads sorrowfully over the price at which the shares were offered. It is now cheaper to buy the stock in the open market than to apply for the new shares, although the price at which the latter were offered was supposed to provide a small bonus to stockholders. Central Londons (undivided) are also easier on pessimistic forecasts of the dividend by a daily contemporary. Baker Street and Waterloo shares are now at a discount.

There will shortly be issued the prospectus of an important traction undertaking under the title of the South Lancashire Electric Traction and Power Company, Limited. The share capital will be £850,000, and Debentures to the extent of £750,000. New issues of Debentures are being made by the Brisbane Tramways and the Dublin Tramways Companies, but the market in these is very limited.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation November 21st.	Closing Quotation Nov. 28th.	Business done during week ended November 28th, 1900. Highest.	Lowest.
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
119,700	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
822,700	Anglo-American Telegraph	Stock	3 %	£3 9s.	73/6	53 — 56	53 — 56	...	...
3,088,540	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	98 —100	98 — 100	100	99
3,088,540	Do. do. Deferred	Stock	...	18s. %	£1 7s.	10¾— 11¼	10½— 11	11	10 13/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	4 %	3 — 3½	3 — 3½	3 3/16	...
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	165 —175	165 —175	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	102 —105	103	...
16,000	Cuba Telegraph	10	7 %	8 %	7 %	6½— 7½	6½— 7½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	14½— 15½	14½— 15½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104%	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3 %	10¼— 10¾	10¼— 10¾	10 7/16	10¼
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	143 —148	140 —145	146	140
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	97 —100	97 —100	98	97
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	112 —116	112 —116	114	112
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	14½— 14¾	14 — 14½	14½	14
50,000	Do. Nos. 250,001 to 300,000 (iss. at £3 pm. all pd.) £3 pd.	10	...	...	...	6½— 7	6¼— 6¾	6¼	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	114 —119	113 —118	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	99—102%	99 —102%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5⅛%	5¼%	10¼— 10¾	10¼— 10¾	10⅝	10 5/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15 — 15½	15 — 15½	15½	15¼
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	12½%	...	31 — 33	31 — 33	31½	...
84,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	49 — 53	49 — 53	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	104 —107	104 —107	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	...	...	2½%	¼— ½xd	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	4 %	5 %	¾— 1 xd	¾— 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	6 %	5 %	4⅜— 4⅝	4⅜— 4⅝	...	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 15	12 — 14	12½	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5 — 5¼	5 — 5¼	5	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 —99	96 — 99	98	96
500,000	Do. 4 % Deb. Stock Red.	100	...	...	...	101 —104	101 —104	103	101½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	...	...	101 —104	101 —104	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	7⅞	...
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	...	...
58,000	United River Plate Telephone	5	5 %	6 %	7 %	4½— 5	4½— 5	...	...
16,639	Do. do. 5 % Cum. pref. Nos. 1—16,639	5	...	...	...	5 — 5½	5— 5½	...	...
23,361	Do. do. Nos. 16,640 to 40,000 £3½ pd.	5	...	...	...	3½— 3⅝	3½— 3⅝	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	106	...
171,000	West African Telegraph, 5 % Debs.	100	...	...	...	98 —101	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,071—53,008	2½	...	...	...	¼— ¾	¼— ¾	¼	...
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Brаs. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	14 —14½	14 — 14½	14⅜	14
75,000	Do do. 5 % Debs. 2nd series, 1906	100	...	...	...	103 —106	103 —106	...	...
348,777	Do. do. 4 % Deb. Stock Red.	100	...	...	...	102 —105	102 —105	...	...
88,321	West India and Panama Telegraph	10	¾%	2 %	⅝%	¾— 1	¾— 1	¾	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	...	...	6½— 7½	6½— 7½	6 9/16	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	...	...	5 — 7	5 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	105 —108	105 —108	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref.	5	7 %	...	...	8½— 9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9½— 10½	9½— 10½	10	9⅞
20,000	Do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	6 %	6¼— 6⅜	6½— 7	6⅝	6 9/16
150,000	Do. do. do. % Deb. Stock Red.	Stock	4½%	...	...	110 —113	110 —113	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579	10	10 %	6 %	4 %	9 — 10	9 — 10	9⅜	9¼
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	13 — 13½	13 — 14	13 7/16	13⅜
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	125 —130	125 —130	127	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	4 %	8½— 9½	8½— 9½	9	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11 — 12	11 — 12	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	108 —111	108 —111	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5	4½— 5	...	...
75,000	Do. do. 4½ % 1st Mort. Deb. Stock.	100	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	1⅞— 2¼	1⅞— 2¼	...	...
49,840	Do. do. do. 6 % Pref.	5	...	6 %	...	4½— 5½	4½— 5½	...	...
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	100 —102	100 —102	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	13 — 14	12½— 13½	13¼	13
220,000£	Do. 4½% First Mortgage Debenture Stock	...	4½%	...	...	112 —115	112 —115	...	...
250,000	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	97 —100	97 —100	98¾	...
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	14½— 15½	14½— 15½	14½	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	15¼	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9	8 — 9	...	...
150,000	Do. do. 3½ % Deb. Stock Red.	100	...	...	...	100 —103	100 —103	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000	Do. do. 4 % Deb.	100	...	...	...	85 — 95	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2⅝— 3⅛	2⅝— 3⅛	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	12 %	12 %	13 %	12 — 13	12 — 13	12⅝	12¼

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

The value of the patents—some of which, by the way, never got

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation Nov. 21st.	Closing Quotation Nov. 28th.	Business done week ended Nov. 28th, 1900. Highest	Lowest
20,000	British Aluminium 7 % Cum. Pref.	‡ 10	...	...	...	9 — 10	9 — 10	...	...
300,000	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	91 — 95	91 — 95	91	...
45,000	British Electric Traction	10	...	6 %	...	13⅛ — 14½	13⅛ — 14½	14 9/16	14¼
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12½	12 5/16
350,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	120 —123	120 —123	121¾	...
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	7/16 — 9/16	7/16 — 9/16	...	...
50,000	† Do do. 6 % Cum. Pref., 1—50,000 ...	...	...	...	...	⅜ — ½	⅜ — ½	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	97 — 99	97 — 99	...	...
70,000	British Insulated Wire Ord.	5	15 %	15 %	20 %	10½ — 11½	10 — 11	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅝ — 6¼	5⅝ — 6¼	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	3 %	5 %	6 %	1⅝ — 1⅞	1⅝ — 1⅞	1⅝	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	2 5/16	2 1/16
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	106 —111	106 —111	...	...
108,710	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	103 —105	103 —105	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	12½ %	15 %	15 %	12½ — 13½	12½ — 13½	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5 — 5½	5¼ — 5⅝	5⅝	5¼
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	S ock	...	...	...	110 —114	110 —114	...	...
206,297	Central London Railway, Ord. Shares	10	...	...	...	10¼ — 10⅝	10 — 10½	10 9/16	10⅛
78,703	Do. do. Pref. half-shares	5	...	...	...	5 — 5½	5 — 5½	5⅝	5¼
78,703	Do. do. Def. do.	5	...	...	...	5 — 5½	5 — 5½	5¼	...
855,000	City and South London Railway	Stock	1⅞ %	2⅛ %	1⅞ %	54 — 58	52 — 56	55	52
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	4½ — 5½	4½ — 5½	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	...	6 %	7½ %	3½ — 4	3½ — 4	...	...
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	6 %	1⅞ — 2¼	1⅞ — 2¼	2	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	6 %	3½ — 4½	3½ — 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	90 — 92	90 — 92	...	...
100,000	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	96 —100	96 —100	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	7 %	...	2⅜ — 3¼	2⅜ — 3¼	...	...
182,500	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	104¼	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	12½ — 13½	12½ — 13½	13	12¼
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5¼ — 5⅝	5¼ — 5⅝	5⅝	5¼
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	...	...	108 —112	108 —112	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	20½ — 21½	21 — 22	21⅛	...
300,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100—103	100 —103	101	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¼ %	3¼ %	3⅜ %	8 1/16 — 9 1/16	8 1/16 — 8 1/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13 — 13¼	13¼ — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 42	37 — 42	40	37½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	... %	101 —104	101 —104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	8 %	12 %	10½ — 11½	10½ — 11½	10 1 5/16	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5¼ — 5⅜	5¼ — 5⅜	5⅜	5 9/16
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	92 — 95	92 — 95	...	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Brompton and Kensington, 4½ % Debentures of £100, 103—106.
National Electric Free Wiring, 12/6 paid, ⅜—½.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16½—17½.
Do. do. Pref. (£10 pd.), 10—10½.
* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 % £5 (fully paid), 6¾—7½. Debentures, 102—105. Dividend, 1899, on Ordinary Shares 11 %.
*T. Parker, £10 (fully paid), 17⅜.

Bank rate of discount 4 per cent. (July 19th, 1900).

MARKET QUOTATIONS, Wednesday, November 28th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	89/-	89/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ,, ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carben	per ton	£15	£15	..
a Borax	per ton	£17 10	£17 10	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25	£25	..
a Lead, Nitrate	per ton	£25	£25	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	3¼d.	3¼d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£25	£25	..
a Shellac	per cwt.	64/-	64/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks ..	per lb.	2¾d.	2¾d.	..

METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots..	per ton	£80 to £150	£80 to £145	..
c Brass (rolled metal 3" to 12") basis	per lb.	7¾d.	7¾d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8¼d.	8¼d.	¼d. dec.
c ,, Wire, basis	per lb.	8¼d.	8¼d.	..
c Copper Tubes (brazed) ..	per lb.	11¼d.	11¼d.	..
c ,, ,, (solid drawn) ..	per lb.	11d.	11d.	..
g Copper Bars (best selected) ..	per ton	£86	£86	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£86	£86	..
g ,, Rod	per ton	£86	£86	..
e ,, (Electrolytic) Bars ..	per ton	£83 10	£83 10	..
e ,, ,, Sheets ..	per ton	£92	£92	..
e ,, ,, Rod ..	per ton	£85 10	£85 10	..
e ,, ,, H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha fine	per lb.	8/6	8/6	..
h India-rubber, Para fine	per lb.	3/11 to 4/1	3/11 to 4/1	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	60/9	61/7½	10½d. dec.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£11 15	£11 15	..
g Lead, English Ingot	per ton	£17 5 to £17 7 6	£17 5 to £17 7 6	..
g ,, ,, Sheet	per ton	£19	£19	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 2 6	£9 2 6	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£3 18	£3 18	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£131 to £132	£131 to £132	..
g ,, foil	per lb.	2/-	2/-	..
m ,, wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	9½d.	9½d.	..
j ,, Best Flax, 6 lea.	per lb.	5¾d.	6d.	¼d. dec.
j ,, Hemp, 2 ply 10 lbs. ..	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5¾d.	5¾d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14 10	£14 10	..
k Zinc, Sh't. (Vielle Montagne ond.)	per ton	£23 2 6	£23 2 6	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Henry C. Yeo & Co.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited. *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company, Ltd.

Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

THE SYNCHRONISATION OF ALTERNATORS COUPLED IN PARALLEL.

[Condensed translation of the second and third parts of a paper entitled "A Study of the Transmission and Distribution of Energy by Alternating Currents," read before the Société Internationale des Electriciens by M. Maurice Leblanc.]

(*Concluded from page* 765.)

A simple method of generating the E.M.Fs. of lower frequency that must be developed between the ends of our secondary circuits is the employment of ordinary continuous current machines, furnished with commutators, whose field-magnets are excited by alternating

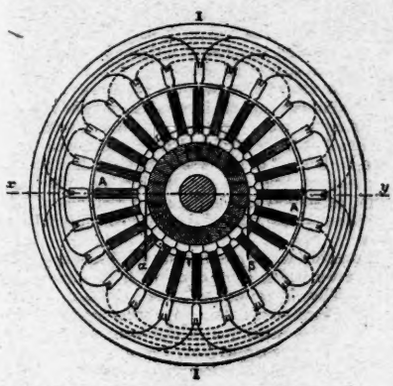


Fig. 12.

currents of convenient frequency. In fact, the E.M.F. developed between the brushes of such a machine would be, at each instant, proportional to the strength of the field current, and consequently, would have the same frequency and the same phase.

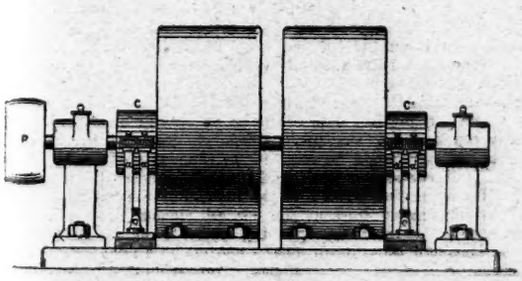


Fig. 13.

The speed of rotation of this dynamo, and the strength of the flux that would be developed in it, being independent of the frequency, this machine will work as well as if it had been required to furnish continuous currents; its dimensions will, therefore, be

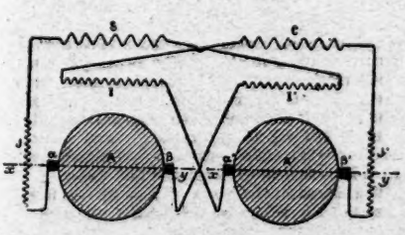


Fig. 14.

very small, if we only require it to furnish real energy, or very little apparent energy. Finally the frequency of the currents which traverse the armature being low, there will be no trouble with the commutation. We are thus led to add to our generator two small continuous current dynamos exactly alike. Each of the two secondary circuits will be connected with one of the armatures of these machines.

The currents which traverse the two secondary circuits being naturally displaced a quarter of a period, each of them will be convenient for exciting the field magnet of the continuous current machine whose armature will be traversed by the other current.

We have represented in fig. 12 a dynamo whose armature, A A, consists of a Pacinotti ring furnished with a commutator C C, upon which the two brushes α and β bear at opposite ends of a diameter. The line $x\ y$ is a diameter passing through the contacts of the brushes.

The field-magnet, I I, consists of a second Pacinotti ring with its teeth turned radially inwards, concentric with the first ring. It is furnished with two windings represented diagrammatically in fig. 12, the first winding by continuous lines, and the second by dotted lines.

A current passed into the first winding will develop a flux following the direction of the line $x\ y$. A current passed into the second winding will develop a flux in a direction perpendicular to the line $x\ y$. The exciter with which it will be convenient to furnish our generator will be composed of two such machines, coupled upon the same axle, as represented in fig. 13, so that one pulley can turn the two simultaneously.

The diagram fig. 14 represents the connections that it will be convenient to make between the secondary circuits of the generator and the several circuits of the exciters; S and C represent the two circuits of the generator. A and A′ are the two armatures of the exciter, and $\alpha\ \beta$ their brushes. J and J′ are the field circuits of the exciter dynamos developing flux in the direction of the line $x\ y$.

I and I′ are the field circuits of these dynamos developing flux perpendicular to the line $x\ y$.

In order to prevent the currents of frequency $(a + n\omega)$ developed in the secondary circuits of the generator passing through the exciter, we impose on these two circuits of the generator other secondary circuits closed on themselves, and consisting, for example, of a squirrel cage. Under these conditions the field which turns with reference to the secondary circuits with the speed $(a + n\omega)$ will not be able to acquire any appreciable value.

The electromotive forces of the same frequency developed in the circuits S and C will therefore be very small, and *a fortiori* the currents that they will pass into the exciter will be small, the impedance of the latter for frequency $(a + n\omega)$ being very great.

Call $i_1 = a \sin 2\pi (a - n\omega)\ t$ and $i_2 = a \cos 2\pi (a - n\omega)\ t$ the strengths of the currents issuing from the circuits S and C which traverse the exciter.

The current whose strength is i_1 in traversing the circuit J, will develop a magnetic field, equal, but of contrary sign to that which it will develop in traversing the armature A. The operation will go on, as if the apparent coefficient of self-induction of that armature was 0.

But the circuit I being traversed by the current whose strength is

$$i_2 = a \cos 2\pi (a - n\omega)\ t$$

the E.M.F. produced by the rotation of the armature A will be equal to $K\ a \cos 2\pi (a - n\omega)\ t$, K being a coefficient depending upon the speed of the armature, its dimensions, and the saturation of its iron core.

We can arrange the magnitude and the sign of the coefficient K as we like. We shall, therefore, be able to arrange so that this E.M.F. may be a quarter of a period in advance of the current i_1.

Note that the circuits S and C, including their extensions, have a coefficient of mutual induction 0. Each of them including one of the circuits I or I′ will have its coefficient of self-induction increased by a quantity λ, which will reduce the action of the dynamo whose armature it traverses, to that extent, these circuits, therefore, will have only a small number of coils, the others being increased. That will present no inconvenience in the matter of commutation, since the inductive reaction of each armature will be directly destroyed by the action of the circuit J or J′, which is connected to it. As to the influence of the variations of the flux which will be produced by the short circuiting of the coils by the brushes, it will be very weak because of the low frequency of these variations. It will be rendered completely negligible by giving plenty of contact surface to the commutators, and by joining these last to the sections of the armature by connecting wires having resistance.

We have just said that in order to oppose the production of the superfluous flux turning with reference to the secondary circuits of the generator, we should arrange a magnetic screen around these circuits. It is necessary to be careful that the screen is not of too low resistance, or it may begin to demagnetise the circuits connected with the exciter.

The author then proceeds to show that:—

1. If the machine is already constructed, we can always arrange an exciter that will allow the machine to furnish wattless currents to the network across which it is connected when the frequency of the slip varies between certain limits, β_1 and β_2.

2. We can *à priori* take any values for the frequencies, β_1 and β_2, and determine, in consequence, the section of the wire of the windings closed on themselves and the power of the exciter.

We have supposed, it is true, that the resistance of the secondary circuits connected to the exciter was *nil* in comparison with that of the circuits closed on themselves. This condition is not necessary, but the resistance of the circuit connected to the exciter must always be small compared with that of the circuit closed on itself. If they were equal, for example, it would be found that the equation of the second degree, which gives the values of β_1 and β_2, had imaginary roots. That is due to the demagnetising action of the circuits which

are closed on themselves. It will be easy, moreover, to fulfil the condition, the resistance of the circuit connected to the exciter being 0, by modifying the exciter which has been described.

We arrange two circuits upon its field magnets, one of N coils, the other of N′ coils, developing magnetic fields in a direction perpendicular to the line of contact of the brushes. The circuits of N coils will always serve for the passage of currents which will be in quadrature with those that traverse the armature. The others will be in series with it.

1. In this manner the armature traversed by a current whose strength is

$$i_1 = a \sin 2\pi (a - n\omega) t,$$

will be subject to the action of a magnet having N coils, traversed by a current of strength

$$-i_2 = -a \cos 2\pi (a - n\omega) t,$$

and N′ coils traversed by a current of strength

$$i_1 = a \sin 2\pi (a - n\omega) t.$$

2. The armature traversed by a current whose strength is

$$i_2 = a \cos 2\pi (a - n\omega) t,$$

will be subject to the action of a magnet having N coils traversed by a current of strength

$$i_1 = a \sin 2\pi (a - n\omega) t,$$

and N′ coils traversed by a current of strength

$$i_2 = a \cos 2\pi (a - n\omega) t.$$

In practice, the two circuits of N coils will be traversed by currents whose strengths are

$$i_2 = a \cos 2\pi (a - n\omega) t,$$

and

$$i_1 = a \sin 2\pi (a - n\omega) t,$$

but in directions opposite to each other. The coefficient of mutual induction of the two circuits will always be 0, and nothing will be changed from that which has been stated before.

But the presence of the two circuits of coils will allow us to develop in the two armatures of the exciter E.M.Fs. of the same phase as the current strengths which traverse them.

It will be easy to arrange so that these E.M.Fs. render the resistances of the circuits artificially *nil*. It would not be necessary, however, to render them negative, for the exciter would then excite itself, and would transform the asynchronous generator into an ordinary alternator.

APPARATUS FOR THE DETECTION AND REGISTRATION OF ELECTRICAL VIBRATIONS.*

By A. C. POPOFF.

(*Concluded from page* 846.)

The accompanying diagram (fig. 2) shows the arrangement of the parts of the apparatus. The tube containing the filings is supported horizontally between the terminals, M and N, by a thin watch-spring, which, for greater elasticity, is bent at one of the terminals into a

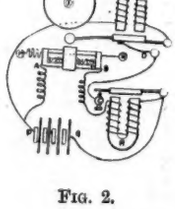


Fig. 2.

zigzag. Over the tube the bell is placed so that when it is actuated it will give slight taps with the hammer on the centre of the tube, which is protected from breakage by an india-rubber ring. A good plan is to mount the tube and the bell on a vertical board. The relay, R, may be placed in any convenient position.

The action of the apparatus is as follows: A current from a battery of 4 to 5 volts constantly circulates from the terminal, P, to the platinum foil, A, then through the powder contained in the tube to the other foil, B, and through the coils of the relay back again to the battery. The strength of this current is insufficient to attract the armature of the relay, but if the tube, A B, is exposed to the action of the electric vibrations the resistance instantaneously decreases, and the current increases so much that the armature of the relay is attracted. At this moment the circuit from the battery through the bell, normally interrupted at the point C, is closed and the bell begins to act; but the tapping of the coherer tube immediately reduces its conductivity again and the relay breaks the bell circuit.

In my apparatus the resistance of the filings after vigorous shaking becomes about 100,000 ohms, and the relay, with a resistance of about 250 ohms, attracts the armature with a current of from 5 to 10 milliamperes (according to the adjustment)—that is, when the resistance of the whole circuit falls below 1,000 ohms. After a single shock the apparatus responds with a brief ring; under the continuous action of the discharges the coils respond with sufficient frequency on account of the bell strokes occurring at approximately equal intervals.

The sensitiveness of the apparatus may be indicated by the following experiments:—

1. The apparatus responds across a large auditorium to the discharges of an influence machine if a thin wire about 1 metre long and placed parallel to the direction of the discharges is attached to the point A or B, in order to increase the energy acting on the filings.

2. When connected with a thin vertical wire 2·5 metres long the apparatus responded in the open air, at a distance of 210 feet, to the vibrations produced by a large Hertzian vibrator (plates 40 centimetres square) with sparks in oil.

3. Placed in a closed zinc case, the apparatus did not respond to the discharges generated in its immediate neighbourhood, not even to sparks passing between the zinc case and the knob of the electrical machine; but if an insulated wire, connected with one of the points A or B, be led out of the case with its end projecting 10 or 15 centimetres, the apparatus responds to vibrations produced by a small Righi, Lodge, or similar transmitter at a distance of 3 to 5 metres; lengthening the external part of the wire considerably increases the sensitiveness.

4. The apparatus is very sensitive to discharges between conductors in direct metallic connection with the circuit containing the coherer tube. Thus if we connect the point A or B with the rod of a discharging electroscope, the apparatus responds to every discharge of the leaves after the electroscope has been charged with 300 volts. Direct discharges from the disc or knob charged by a dry pile of about 500 volts electromotive force actuate the bell, the energy of the charge being less than 5 ergs.

5. The apparatus responds to the spark formed at the moment of breaking an independent circuit, if this circuit is metallically connected with that containing the filings; as, for example, if we close a Grenet cell by a wire from terminal to terminal, and connect one terminal with the point A by a short conductor. If the interrupted circuit contain an electro-magnet the action of the spark which occurs on breaking the circuit may be transmitted to the apparatus through a very long conductor. Self-induction and capacity in the conductor transmitting the vibrations doubtless considerably diminish the transmitted energy. For this reason the sparks produced on the interruption of the bell circuit at the points C and D act but feebly on the coherer; even the spark at D is of no importance, since at the moment when the conductivity of the filings is destroyed contact is made at the point D. For this reason the arrangement of the parts of the apparatus, as shown above, appears to be the only possible one. With other arrangements failure may easily result, seeing that the conductivity destroyed by the motion of the hammer might be restored by the action of the sparks produced in the apparatus itself, and the bell would ring continuously.

6. The apparatus when inserted instead of the telephone in one of the disengaged lines at the central station, did not respond either to the rings or the speaking currents on the neighbouring lines, although these were clearly audible in a telephone if it was inserted instead of my apparatus. Sometimes it responded to certain rings indicating the end of a conversation, and at the moment of hanging up a telephone in its place on one of the neighbouring lines; but at those instants rapid vibrations may have been generated in the circuits by the formation of sparks.

7. Apparently the apparatus is also sensitive to slow discharges passing through the filings, but only when the energy is considerable. Thus, the apparatus responds to rapid movements of an electrified ebonite rod in the neighbourhood of the conductors of the apparatus; but slow movements have no effect on it. The current generated in the secondary of an induction coil, on breaking the primary circuit during a discharge through the filings, either directly or with a condenser successively inserted in this circuit, always acts on the filings, producing sufficient decrease of resistance, but the current produced in closing the primary circuit acts more feebly and irregularly. An effect of this kind, moreover, agrees with the hypothesis adopted by me above. The apparatus is actuated by the discharge from the knob of an influence machine through a wet string about 1 metre long, suspended from one of the points A or B, if the string be moistened with acidulated water, but does not respond if it be moistened with distilled water.

As a result of these experiments it may be assumed that every discharge through the filings may have the effect of reducing the resistance, but the magnitude of the effect depends not on the absolute amount of energy acting on the metallic powder, but on the energy expended in unit of time—more accurately, on the rate of expenditure of energy, or on the magnitude of the ratio $\frac{\text{energy}}{\text{time}}$. The filings are therefore more sensitive to rapid vibrations for the same amount of energy.

An instrument possessing so much sensitiveness may serve for various lecture experiments on the electric vibrations, and if

* Translation of paper from Russian Physical and Chemical Society's *Journal* for January, 1896.

commutation. We are thus led to add to our generator two small

roots. That is due to the demagnetising action of the circuits which

enclosed in a metallic case may be easily adapted to experiments on electric rays; in many similar experiments the apparatus, as arranged by me, possesses too much sensitiveness. But thanks to the fact that the relay may vary in sensitiveness within certain limits, we may by varying the number of cells, easily obtain the desired degree of sensitiveness.

Another feature of the apparatus, which may give further interesting results, is its ability to indicate the electrical vibrations which occur in a conductor connected with the points A or B (see diagram), in the case where the conductor is exposed to the action of electro-magnetic disturbances in the atmosphere. For this purpose it is sufficient to connect the apparatus—protected against all other action—to an aerial conductor placed at a distance from telegraphs and telephones, or even with a lightning conductor. Each vibration exceeding in intensity a certain limit, will be indicated by the apparatus, and even recorded, as, each time the relay makes contact at the point C (fig. 2), a recording electro-magnet may be brought into action, in addition to the bell. For this purpose one end of its coil is connected at a point between C and D, and the other to the battery terminal P; that is, the electro-magnet is joined up in parallel with the bell.

Experiments with the apparatus in connection with aerial lines of considerable length are sure to give more or less interesting results. I happened to be one summer in the Ural for a "cure," and far from other telephone lines,* and during that time if one took the telephone in one's hand distinct rhythmic sounds could be heard, and also very frequently, the hissing, whistling, and crackling of a discharge. As evidence of the character of the phenomenon occurring on this line, although these sounds were heard in winter as well as in summer (I observed them from May until September), the interference with transmission of speech was not great in the former case, but in summer communication was sometimes rendered difficult by it.

Experimental trials of the recording apparatus in connection with a lightning conductor were carried out last summer by M. A. Luboslavsky in the Institute of Forestry at St. Petersburg.

On the Institute building, among other appliances designed for the observation of the direction and force of the wind, a small wooden mast was erected, at the top of which was fixed an ordinary lightning rod point. This point, by means of a wire running down the mast and then stretched across the courtyard on insulators to the Meteorological Cabinet, was connected to the point A of the apparatus (fig. 2). The point B was connected, in common with other meteorological apparatus, to a conductor which was put to earth by means of the water pipes. The recording portion consisted of an electro-magnet, to the armature of which was connected a stylus from one of Richard Frères' registering instruments, and of a cylinder by the same firm, giving a weekly record.

With this arrangement the apparatus responded with a ring, and a mark, each time the current was sent by the anemometer, during the observation of the direction and force of the wind, these effects being due to the fact that the system of conductors is in connection with the apparatus through the common earth wire, and electric vibrations are excited at the moment the current is interrupted.

In order to distinguish these marks from others produced by atmospheric electricity, the observers, when such signals were given, made a note of the circumstance on the cylinder; these extraneous effects on the apparatus, however, were allowed to continue as a check upon its accuracy.

The experimental apparatus, though not perfectly satisfactory, was brought into use in the latter part of July (new style) and afterwards, during the last days of August (new style), and gave the following results:—

July 30th.—According to records of principal Physical Observatory, thunderstorm from 10.40 to 11.40; by record of the observatory of the Institute of Forestry, thunderstorm about 1 o'clock in the day. The apparatus gave a series of marks, running together, and following each other for the space of 40 minutes in the interval between 12 and 1 o'clock.

August 21st (N. S.)—At the principal Physical Observatory the records states: thunderstorm from 4.50 to 5.50 p.m., nearest approach 3 seconds at 5.17, and thunderstorm from 8.37 to 9.10 evening—nearest approach at 8.40. Storm noted by the observers of the Institute of Forestry, and registered by the apparatus in a series of marks following each other uninterruptedly from 4.50 to 8.50 p.m.; during the night the apparatus recorded a few more marks.

August 23rd (N. S.)—Apparatus gives an interrupted record commencing at 1,15 and lasting 25 minutes, and another record after 9 p.m. continuing for 1 hour 20 minutes.

No notes of a thunderstorm or rain were made by the observers of the Institute.

August 25th.—The apparatus records:—5.45 a.m., duration 20 minutes, marks at 9.10, at 10.0, nearly uninterrupted record from 10.25 a.m. to 7.45 p.m. On this date rain was noted up to mid-day at 1 o'clock and in the afternoon. According to the statements of the student observers the apparatus rang for 5 or 10 minutes at a time during the whole day.

M. A. Luboslavsky was absent that day. According to his observations the day was sultry with a large amount of cumuli. At the principal Physical Observatory there were no notes of a storm.

August 26th.—Marks recorded: 9 a.m. and 12.5 p.m.; after the latter observation, the glass tube containing the filings broke; at 12 p.m. rain was noted by the observer.

The apparatus was again brought into use at the end of September (old style), with a modification of the registering mechanism. The weekly cylinder was replaced by a 12-hour one, and the record was made on a telegraph slip wound on the cylinder. The speed at which the slip moved was 23 mm. per hour. It was easy to distinguish clearly on the slip the strokes following each other. The apparatus stood in its former position, unprotected from the action of the meteorological apparatus, in which electric currents were used, and from the effects of occasional discharges during work in the physical cabinet. If, therefore, the record of the apparatus be examined from hour to hour, it may be ascertained beyond doubt, that only part of the indications are produced by atmospheric discharges. The marks recorded in the period of time between 11 p.m. and 7 a.m., are, however, not open to doubt, as during that time the cabinet in which the apparatus is placed and all the neighbouring rooms of the building are closed. The apparatus gave indications of this kind for example, on October 6th, at 12.45 p.m. and 5 a.m.

In this period may be noted the 24 hours from September 24th to 25th. September 24th was Sunday, and the cabinet was closed. On this date there were indications at 8.51 a.m. and at 5, 5.45, and 6 p.m.; at 5 a.m. in the following day, and at 9.25 a.m. Indications were expected on September 24th. I and M. A. Luboslavsky were at that time in St. Petersburg, and M. Luboslavsky having called my attention to the gathering clouds, similar in shape to thunder clouds, remarked that it would be interesting to know whether the presence of these clouds would be indicated by the apparatus. Later in the evening of that day there was very heavy rain having the character of summer showers. In the middle of October the experiments were discontinued in consequence of certain indispensable alterations in the experimental apparatus. The battery of four Leclanché cells, used up to this time in the experiments, became exhausted. At the present time the apparatus is again in operation with a battery of six Meidinger cells.

During the experiments with the apparatus in the summer period it was necessary for safety to join up a lightning arrester in parallel with the coherer tube.

It may be useful if I add a few remarks on the adjustment of the apparatus. The bell must be adjusted so that the hammer may have as great an amplitude of vibration as possible, and the coherer tube must be placed at such a height that it barely touches the hammer when the latter is in the position of rest, and does not follow it by the action of the springs. Only under these conditions will the instrument respond with precision, with a brief ring after each separate shock.

In view of the results obtained in the experiments described above, the desire may perhaps be expressed that those persons who are interested in the observation of thunderstorms will give the apparatus a more extended and careful trial.

In conclusion, I may express the hope that my apparatus, when further perfected, may be used for the transmission of signals to a distance by means of rapid electric vibrations if only a source of such vibrations can be found possessing sufficient energy.

* The line extended for a distance of 15 versts (10 miles) from West to East along a spur of the Ural Mountains in the Bogoslovski district.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

The tenth annual meeting of the American Electro-Therapeutic Association was held in the Academy of Medicine, New York City, September 25th, 26th, and 27th, 1900, under the presidency of Dr. Walter H. White, of Boston, Mass.

The report of the Committee on Electrodes was presented by Dr. Charles R. Dickson, of Toronto, Chairman; several new electrodes were submitted for inspection by Dr. Walter H. White, Mr. R. G. Brown, E.E., of Brooklyn, N.Y., and Dr. C. R. Dickson; the recommendations of the committee in regard to the standard dimensions of connections, and the manner of marking bipolar electrodes were adopted by the Association.

Rev. Newman Lawrence, of Stapleton, Staten Island, read a paper on "Electro-Therapeutic Sins," scoring vigorously the use of electricity by those who did not understand it, the fraudulent character of so-called electro-magnetic body appliances, and the testimonial evil. A discussion on "Electricity in Tuberculosis and Present Modes of Treatment," was taken part in by the following:—Dr. S. A. Knopf, of New York, spoke on the "Etiology of Tuberculosis, its Course and Termination." Dr. M. J. Brooks, of Stamford, Conn., dealt with "The Modern Treatment of Pulmonary Tuberculosis." "Electric Light as a Therapeutic Agent," was presented by Dr. Charles O. Files, of Portland, Me. "Electric Light; its Physiological Action and Therapeutic Value in Tuberculosis of the Throat and Lungs," was the subject of Dr. Wolff Freudenthal of New York. Dr. Egbert LeFevre, of New York, gave a "Report on the Practical Value of Grotte's Method and of Others who Advertise Cures." The report was not of a favourable character. A committee was appointed to investigate the method of M. Grotte, consisting of Drs. William J. Morton, Robert Newman, and Emil Heuel, of New York. Dr. J. Griffith Davis made a "Plea for the Better Application of Electricity in Diseases."

Some New Appliances for X Ray Work.—Mr. E. W. Caldwell, E.E., of New York, brought out an improved stand and holder for the X ray tube, discarding the rigid clamp for a spring; an ingenious shelf for supporting the arm in any position and steadying it there; a device to keep the limbs in the same relative position in taking radiographs of the hip joint; and a suggestion to interpose a thin sheet of celluloid to prevent injury to the plate by the moisture of the person's body.

Society's *Journal* for January, 1896.

An instrument possessing so much sensitiveness may serve for various lecture experiments on the electric vibrations, and if

Combined Electrisation, or Galvano-Faradisation.—By Dr. A. D. Rochwell, of New York. Among the advantages of combined treatment over the use of either current alone, he instanced the more powerful excitation of contractile fibre cells, greater stimulation of waste and repair, stimulation of osmosis, increase of heat production, and especially its value in local spasmodic conditions and the control of the symptoms of exophthalmic goitre.

Gleanings in the Field of Electro-Therapeutics.—By Dr. Charles O. Files, of Portland, Me. Several suggestive cases were alluded to. During a double amputation of the thigh about an hour after a railway accident, the patient suddenly developed symptoms of severe shock to such an extent that he appeared to be dead; the prompt application of galvanism with one pole to the epigastrium and the other to the base of the brain revived the patient almost immediately; electrisation had to be resorted to at short intervals for three weeks to avert collapse; the patent completely recovered. Every surgeon who had seen the case during the first fortnight had given a practically hopeless prognosis. A second was a most gratifying improvement following electricity and massage in a case of incipient tuberculosis. Electricity was a most valuable ally as an hypnotic, and in many inveterate cases of facial neuralgia persisting after operative measures for relief.

Discussion on Electricity in Gynecology, and the Present Reluctance of Gynecologists to use Electricity: The General Office Work of a Gynecologist.—Dr. Fred. H. Morse, of Melrose, Mass., outlined the value of electricity in diagnosing the presence of deep-seated pus; in metritis, endometritis, subinvolution, uterine displacement, ovarian neuralgia, painful menstruation, electrical treatment was most satisfactory; in acute inflammatory conditions electrical treatment was not contra-indicated, but special care was requisite then; a reliable battery, amperemeter, and a good high tension faradic battery were absolutely essential; asbestos cloth made a capital dispersing pad.

The Morton Wave Current—A Valuable Addition in Electro-Therapeutics.—In the absence of the author, Dr. W. B. Snow, of Atlanta, Ga., this was read by Dr. C. R. Dickson. The wave current was unique in many respects; thus, it was administered from but one side of the generator, the alternations were of charge and discharge, though of high potential it could be passed to and fro through the body with little discomfort; the patient received general electrisation; the surges of the current passing through the tissues of the body, it permitted the use of the highest possible electromotive force; it was readily controllable; the constitutional effects were marked lowering of arterial tension, lessened frequency of the heart's action, and increased volume of pulse, increased oxidation and metabolic activity, marked diminution of nervous irritability, with sense of drowsiness, and a sense of fatigue if the treatment was too prolonged; it was indicated in all atonic conditions, chronic menstrual disorders, uncomplicated neuralgias, sciatica, sprains and bruises, and many other conditions.

The Nervous Disorders Peculiar to Women—Dr. G. Betton Massey, of Philadelphia, dealt chiefly with the relation of neurasthenia to these disorders, and the frequent need for well-regulated and properly directed activity as opposed to the notion of rest.

Use of the Continuous Current and Electrolysis.—Dr. Robert Newman, of New York, outlined his successful use of electricity for many years in a large range of cases, including the absorption of pelvic exudates, prolapsus uteri, fibroid tumours.

Spark-Gap Currents, viz., Franklinic Interrupted, Static Induced, and Wave Currents.—By Dr. William J. Morton, of New York. The wave current, or "displacement current," presented more advantages than either of the others, it embodied all that could be obtained from an electrostatic machine in current form for therapeutic purposes; it was of especial value in neurasthenia and all cases where it was desired to improve the general nutrition.

On Methods of Generating and Transforming Electric Currents for Therapeutic Uses, by Mr. Charles T. Child, E.E., technical editor of the *Electrical Review* (N.Y.), was, in his unavoidable absence through illness, delivered by Dr. C. R. Dickson from Mr. Child's manuscript. The officers and a large number of the members of the New York of Electrical Engineers were present on invitation. The direct Society current was a special case of the alternating current, in which the frequency was reduced to zero; the maximum of pressure for therapeutic use was 60 or 70 volts; the battery, though it had recently celebrated its centennial, was still far from perfect; the so-called dry battery was only useful for small currents and for short periods; for motors and cauteries, storage batteries were the best. High pressure currents were reduced for therapeutic use by employing a shunt around a resistance such as coils or lamps; static machines generated potentials up to several hundred thousand volts.

Value of the Cataphoric Method in Cancer.—By Dr. G. Betton Massey, of Philadelphia. The method consisted in driving the salts of mercury into the cancer by cataphoresis with heavy electric currents; the patient being etherised and placed on a large leaden plate covered with heavy pads, constituting the negative electrode, the positive being a tube of gold with amalgamated tip through which mercury was injected; 300 or 400 milliamperes of current were used, sometimes for two hours or more. An inodorous slough separated in one to three weeks. Eleven out of 37 cases had been successful; in 22 the treatment had been begun too late. The treatment was not intended to take the place of the knife, but was very applicable to early manifestations, particularly carcinoma of cervix uteri, and before metastasis.

The Causes of Some Cases of Neurasthenia and their Treatment.—By Dr. Francis B. Bishop, of Washington, D.C. A systematic quantitative analysis had showed quite commonly a diminution of the daily quantity of urea and an excess of phosphates; muscular tissue seemed to be the chief seat of the metabolism; exercise increased the output of urea; the object should be to promote chemical changes by muscular exercise, which ordinarily was followed by fatigue, and such cases were already fatigued, therefore he used electricity, beginning with a mild galvanic current to stimulate the cells of the brain and spinal cord, followed by general galvanisation, and then by general faradisation; lastly, about 15 minutes in the ozone cage with static spray.

X Ray Photography.—By Dr. E. R. Corson, of Savannah, Ga. Unless the X rays were powerful enough to penetrate the bone, details could not be properly brought out. Mere length of spark did not indicate the efficiency of apparatus. By increasing enormously the number of interruptions, the quantity of current passing through the tube was augmented, and efficiency proportionately increased. A coil giving a spark of only 8 or 10 inches and all the current the X ray tube could stand, was recommended; also the use of a hydrochinone developer. All negatives, no matter how strong, should be intensified after development; this gave sharp contrasts, showing no flesh.

Electricity in Brain Failures.—By Dr. D. R. Brower, of Chicago, Ill. The frequency of cerebral neurasthenia was to be attributed to the almost universal condition of unrest, keenness of competition, drifting away from the authorities of the past, and not a little to "young America" and the "new woman." It was frequently associated with disorders of the intestinal tract, or with dilatation of the stomach; daily *séances* of intra-gastric electrisation lasting five minutes, carried out by the patient himself three or four hours after a meal, with attention to diet, with intestinal faradisation by the physician, galvanisation of the brain, and bulbar galvination, followed by static insulation, were recommended.

Electro-therapy of Insanity.—By Dr. Alfred T. Livingston, of Jamestown, N.Y. The author had been using electricity in the treatment of mental disorders for about 19 years. The calmative effect of the galvanic current in some cases was very marked; the treatment was founded on the theory that insanity was dependent largely, in the first instance, upon circulatory changes in the brain. An earnest plea was made for larger medical staffs in insanity hospitals, and the better treatment of insanity in the earlier stages.

Dr. Ernest Wende, of Buffalo, was elected President for the ensuing year.

INSTITUTION OF ELECTRICAL ENGINEERS.

TELEGRAPHS AND TELEPHONES AT THE PARIS EXHIBITION.

By J. Gavey, M.Inst.C.E., M.I.E.E.

(*Abstract of Paper read November 22nd*, 1900.)

The successive Universal Exhibitions that have been held in Paris since the year 1878 may not inappropriately be regarded as milestones along the road of progress in telegraphic and telephonic industries, for each in its time has not only afforded unrivalled opportunities for the study of new work, but collectively they offer conclusive evidence of the value of the various discoveries or fresh departures that have been made from time to time in various fields of research, and the degree of success that has been achieved by past inventors and workers may usefully be laid to heart by those engaged in similar efforts at the present moment. Thus, for example, glancing back at the reports of the Paris Exhibition of 1878, there will be found in the list of telegraphic exhibits the Hughes type-printing, the Baudot multiple, the duplex, the quadruplex, the Wheatstone, and other systems which have achieved permanent success, as is forcibly illustrated by the State telegraphic exhibits of working apparatus in the 1900 Exhibition, in which they all appear as instruments in daily use. On the other hand, many apparently promising inventions which were prominent in the 1878 and in successive exhibitions have either dropped out of sight altogether or are still in the course of development—so far, at all events, as actual practical use is concerned.

Class 26 in the catalogue includes telegraphs, telephones, and phonographs, and I propose to deal with the sub-divisions in this order. Further, I may add that in the brief review that I have undertaken of the exhibits in this class, I propose to dwell only on those which show considerable novelty, or which illustrate the progress made during the last decade, rather than to attempt an exhaustive description of the class as a whole.

Under the head of telegraphs there are three distinct systems of telegraphy which deserve special mention, each exhibiting considerable merit from the scientific point of view, although possibly they may be unequal from the practical standpoint. They are designed either with a view of increasing the amount of traffic which can be carried by a telegraph circuit, or of abolishing the transcription at the receiving instruments necessary with Morse methods; but they are based on very different principles.

Rowland's Multiplex.—The Rowlands Telegraphic Company, of Baltimore, Maryland, exhibit an apparatus of the multiplex type of working which will admit of eight messages being sent simultaneously, four in each direction. The apparatus was at work in the Exhibition, and we were told that satisfactory results had been obtained over a distance of 600 miles of actual line in America. This is in excess of the mileage over which we have been able to work in this country with Delany's multiplex.

(A modification of the multiplex system has been designed by Mr. Pollock, of the General Post Office. The arrangement consists in dividing the commutators into two concentric series, one for transmitting and the other for receiving, and mounting them so

district.

moisture of the person's body.

that one series may be revolved relatively to the other by a variable adjustment; by this means it is possible to arrange that the receiving contacts shall lag behind the transmitting ones for exactly the period taken by the current in traversing the line. This method is still under experimental trial, but it is at present only adapted for Morse signalling.)

The Rowlands apparatus has the following promising characteristics :—

Messages are transmitted from several sets of keyboards of the typewriting character, and any typewriting clerks should, with a little practice, be able to manipulate them. The messages are received on instruments which print them in ordinary type on a long roll of paper, which is perforated at convenient intervals to facilitate division when the received messages are printed.

The electrical apparatus consists of an alternate current dynamo as the source of power, from which a continuous series of electrical undulations traverse the circuit when no printing signals are being sent.

The synchronism between the receiving apparatus and the alternating currents, on their arrival from the distant office, is provided for by means of a small continuous current motor, to which is rigidly geared a little alternator, both fixed on a shaft in the same axial line as the main driving shaft of the receiver. A circuit in which are two condensers, which are alternately charged and discharged from a battery by the to-and-fro movement of the main relay tongue actuated by the received alternations, is so connected up with the alternating motor on the receiver, that when the received undulations from the line and those due to the local alternator on the receiver are in unison, only a continuous uniform beat is heard in a telephone used as a synchronising detector. The speed of the receiving alternator is varied by the insertion of resistance in the motor driving it until this result is arrived at. Once attained, synchronism is maintained automatically by the local alternator acting either as a dynamo or motor, according as the speed of the shaft tends to advance or recede. The main driving shaft on which the printing mechanism is mounted is revolved by a second independent motor, and by suitable adjustments of the resistance in this motor circuit the correct speed is arrived at. This done, then so long as the two shafts run with absolute uniformity a little jockey wheel connected to the first rides on a small insulated point in a disc attached to the second. If the main driving shaft lags, the jockey wheel makes a brief contact which reduces the resistance in the circuit of the driving motor, thereby increasing its speed, whereas if it advances a second contact is made which energises an electro-magnet and establishes a magnetic brake by the generation of eddy currents in a copper disc revolving between its poles. The synchronising of the two sets of apparatus, therefore, is a relatively simple matter; and as the receiving apparatus is synchronised so as to run in unison, not with the disturbing disc at the forwarding end, but with the retarded currents which arrive at the receiving end, there is no reason to doubt the possibility of working for much longer distances than is possible with the original Delany system.

Geared to the shaft of the sending alternator is a distributing commutator with 52 segments, and four groups of 11 consecutive segments are connected each to a set of 11 levers actuated by the transmitting keys. The odd segments serve other purposes. A second series of four equal segments are connected each to one of the four sets of keys, and these acting on a special electro-magnet on the keyboards admit of any depressed type key actuating the corresponding levers at the right periods only.

When no type keys are depressed, the alternator sends a continuous series of undulations to line, whilst the depression of a key by actuating two out of the 11 levers on the keyboard causes two half waves, always with a complete undulation between them, to be cut off, and this suppression of current actuates the receiving apparatus.

The receiving relay has two tongues: one, already referred to above, serving to establish and maintain synchronism; the other actuating either the printing relays or those for shifting the paper. Each of the four type receivers has 11 electro-magnets in the local circuit of the second tongue of the line relay, each electro-magnet being connected to a segment of the receiving commutator which corresponds with, and revolves in synchronism with, the main commutator on the transmitting dynamo. When no signals are being sent, the currents from the line relay pass through the local relays in such a direction as to keep the tongues against the spacing side, but the omission of two half-waves causes the tongues of the two corresponding relays to drop over to the marking side, and this acts on the electro-magnets, which print the corresponding letters, or which shift the paper, as the case may be.

A revolving cylinder with a transverse mark, on the transmitting keyboards, keeps the typewriter at the far end informed of the position of the receiving roll, and advises her when to advance it vertically and shift it horizontally so as to commence a fresh line.

It is stated that each operator can send at the rate of 30 words a minute, so that with duplex arrangements a speed of 240 words should be obtained, with the advantage that the messages are detached from the receiving instruments in a condition to be sent out for delivery, without the necessity for transcription that the existing method of multiple Morse working of course involves.

Mercardier's.—Monsieur Ernest Mercardier, of Paris, exhibits his multiple telegraph system, in which it is said that 24 messages can be simultaneously transmitted over one circuit, 12 in each direction. It is based on the harmonic system of telegraphy, one form of which was devised by Elisha Gray many years ago. Mercardier's method, however, is not a copy of Gray's, as by the use of telephone receivers and transmitters combined in various ways he has designed an absolutely independent method.

As transmitters, Mercardier uses electrical vibrating reeds of a well-known character, and as receivers he uses a combination of a telephone and a microphone, the latter sending out a powerful series of undulations into the local circuit; these undulations are selected by suitably designed telephones, which only respond to the vibrations to which they are tuned.

The method, therefore, is a Morse method pure and simple, in which, so far as the operating is concerned, the telegraphist uses a Morse key for signalling, and the receiving telegraphist uses telephones as sounders. I learnt, whilst in Paris, that the apparatus had, in the course of certain trials, worked satisfactorily between Paris and Bordeaux, but it requires a metallic loop for thoroughly satisfactory working.

Virág and Pollak.—Messrs. Virág & Pollak exhibit their photo-autographic telegraph apparatus, in reference to which so much has appeared in the public press.*

Telephones.

The advance in telephonic practice has, on the whole, been greater than in the branch of telegraphs devoted to the transmission of public messages. The invention and perfection of the manufacture of dry-core paper insulated cables has resulted in the more important of the telephonic administrations, both in the Old and New Worlds, undertaking the substitution of metallic in place of earth circuits for telephonic intercommunication. With the means at their command at an earlier period telephone engineers were practically restricted to overhead work at their large exchanges, and although they realised the disadvantage of earth circuits, few of them could face with equanimity the doubling of the huge number of overhead wires necessary for metallic loops. Now a dry-core cable which will serve 200 subscribers may be drawn into a 3-inch pipe, and in the course of a few short years an earth circuit telephone will be a thing of the past. Not only has this resulted in a silent and undisturbed subscriber's circuit, but it has admitted of the introduction of improved telephones and improved switching arrangements. With an earth circuit a low power microphone had necessarily to be used in order to diminish the disturbance on neighbouring wires, for obviously the greater the current emitted, the greater the mutual induction, but with metallic loops improved telephones of the granular type have been generally introduced. The placing of the wires underground has likewise admitted of increasing the number of subscribers connected to each central switch, and this has led to improved methods of automatic signalling.

There is, perhaps, one point in modern telephone work which may here be referred to with advantage, and that is the general tendency in the direction of the introduction of automatic signalling in modern exchanges. When first the Post Office opened its local exchanges in the provinces Sir William Preece insisted on the need for this method, in order not only to simplify the work of the subscriber, but to ensure the sending of a ring-off signal to indicate the close of a conversation.

At that date automatic signalling could only be effected by the use of primary batteries at the subscriber's office, and objection was taken to the method on account of the alleged expense of these batteries. Given, however, the necessity for maintaining a couple of speaking cells at each subscriber's instrument, the extra cost involved by the addition of two or three more cells for signalling purposes was not so great as was imagined, for a considerable portion of the total maintenance cost arose from the loss of the men's time in locomotion. The principle has, however, spread, and most modern installations at present comprise some method of automatic calling and clearing signals. The diminution in the work thrown on the operator by the use of a well-designed method of signalling, which reduces the speaking to the mere words, "Number, please," "through," or "busy," is highly advantageous in respect both of economy of working and of facility of manipulation.

Central Battery Telephone Switches.—A central battery automatic signalling exchange switch, exhibited by the Western Electric Company, illustrates the system that is being rapidly extended throughout the whole of the United States, and which has been adopted by the British Post Office in London, by the National Telephone Company in some of its centres, and by the Belgian Administration in Brussels. The system has been described recently by myself and others, and space forbids a complete technical description, which would demand a separate paper for due consideration. For the purpose of discussion, however, it may be stated generally that the advantages claimed in favour of the system are broadly of the following character:—

1. The generation of current in an economical manner at the central exchange for speaking and signalling purposes.
2. Uniformity in the character and volume of articulate speech owing to the speaking current being always necessarily maintained at the point of highest efficiency.
3. Economy of maintenance owing to the absence of primary batteries, and the reduction of the parts liable to get out of order at the subscriber's office to the minimum.
4. A complete system of automatic signalling which reduces the need for the operator's intervention to the lowest degree.
5. The use of small glow lamp signalling indicators which admits of each indicator being placed in immediate proximity to the jacks or cords to which the indications refer.
6. The possibility of using coloured lights to indicate special rights, such as toll rates, flat rates, deposit accounts for trunk conversations, &c.
7. The use of a telephone meter for registering the number of conversations initiated by toll subscribers. This method is not necessarily confined to central energy switches.

Postel-Vinay Switches.—The French firm of Postel-Vinay exhibited a system recently introduced at the newest of the Paris exchanges

* See Electrical Review, October 19th and 26th, 1900.

near the Avenue Breteuil, the most striking feature of which is a remarkably small and well-designed automatic indicator which can be placed immediately over the jack for working the junction circuits. A set of these is shown on the table, but I think that signalling lamps are, on the whole, preferable to electro-magnetic indicators.

Siemens & Halske.—The firm of Siemens & Halske also exhibit a flat board of considerable capacity with certain details of signalling which are of interest. Time does not admit of a general description, but there is one point of novelty to which reference should be made—that is a combined local subscriber's jack and indicator. The call is indicated by the appearance of a small disc at the mouth of the jack. The disc is attached to the extremity of the armature of a Hughes electro-magnet. It is held in position by the magnetism of the core, is released by the reversing action of the current indicating the call, and is restored to its normal position by the mechanical insertion of the answering peg. It is, of course, again held in position by the permanent magnetism of the retaining electro-magnet.

Again, an ingenious method of automatic ring-off is provided by means of a local battery joined through the indicator at the exchange, the effect of which is neutralised by an opposing polarisation cell at the subscriber's office, which is in circuit when the speaker's telephone is off the hook. At the close of the conversation, however, and on the restoration of the telephone, this second cell is cut out of circuit, the local battery in the exchange actuates the indicator and the connection is severed by the operator.

It may be observed that Messrs. Siemens & Halske in their descriptive pamphlet specify the following conditions for satisfactory exchange working:—

1. The exchange should possess the greatest possible facilities for accommodating new subscribers, hence—

(*a*) The jacks must be as small as possible, yet not so small as to impair their insulation and durability.

(*b*) All other parts must also be very small and compactly built (the indicators are placed out of reach and are self-restoring).

2. To economise expenditure for working, fitting and space, the manipulation required must be reduced to a minimum, so that one operator may attend to as many subscribers as possible. To achieve this—

(*a*) The indicators must be self-restoring, and the operator's speaking apparatus must be placed in circuit automatically.

(*b*) The clearing signal must be perfectly certain in its action, and must not depend on the subscriber.

Party-line Telephones.—Several forms of party-line telephone circuits have been designed and exhibited, *i.e.*, arrangements designed to serve several offices on one circuit. These are used largely on light railways to provide communication between the headquarters and the various stations on a circuit, each being called by a step-by-step arrangement at will, without disturbing the others. The step-by-step switches which are placed at each office are actuated by battery currents of one polarity, and when these switches are in the position indicating the number of the office required, a reverse current is used for ringing up the "Wanted" subscriber. A needle on each of the dials indicates the number of the office that has been called, and by so doing it further announces the fact that the line is engaged.

There were likewise one or two automatic telephone switches which provide for subscribers to a small telephone system obtaining connection with other subscribers without the intervention of a switching operator. So far these systems have a limited use where a service designed to provide for special conditions is required.

A neat little switchboard for private use was shown by the "Société par Actions du Bureau Electrique," in which connection between any two lines is effected by pressing a button, which makes the necessary line contacts and remains depressed until, on the receipt of the ring-off signal, it is released by giving it a quarter revolution on its axis. It then springs back automatically into the position of rest and restores everything to the normal condition. The use of pegs and cords is thereby dispensed with.

Carbons for Microphones.—The manufacture of carbon granules for microphones has received considerable attention. These appear in two forms—one the irregular granule that has so far been most generally used in this country, the other consisting of small spheres varying in size from ordinary dust-shot to the $\frac{1}{16}$th of an inch in diameter. There appears to be little to choose between the two forms of granules for microphone purposes.

I observed great diversity in the details of construction of telephones and microphones exhibited by French firms. The State Administration compels subscribers to provide their own telephones, and these may be purchased at will from any one of a number of manufacturers who comply with the specification of the Administration. The result is that a very large number of local manufacturers have sprung up throughout the country, each exhibiting a special telephone which differs in some local detail from all others. The result, from an exchange point of view, is not good. The speech from different subscribers varies materially according to the type of instrument used, and none of these local inventions are better than the ordinary type of telephone in use in this country.

As illustrating various modern methods of laying underground conduits for telephone and power circuits, the cement duct system designed by Mr. Hultman, of Stockholm, was exhibited in the Swedish section, and the Belgian Administration showed in their State Pavilion a section of the single duct built-up system, which they have laid in Brussels. Both these methods are in use in this country; the Hultman system having been very largely used by the National Telephone Company, whilst the single duct built-up method has been adopted by the Post Office for its London telephone system. The Hultman system is, perhaps, the cheaper of the two, whilst, on the other hand, the built-up system is, I consider, the stronger and more reliable.

Wireless Telegraphy.

There are four exhibits of wireless telegraphy in the exhibition.

Post Office System.—An illustration by means of coils of the Post Office electro-magnetic method originated by Sir William Preece appears in the Post Office exhibit.

Ducretet and Popoff.—Monsieur Ducretet exhibits his Hertzian system, which it is understood he designed in conjunction with Monsieur Popoff, the Russian inventor, and which has been adopted in the French Navy, and, it is believed, in the Dutch. There was nothing to specially distinguish it from the Marconi system in this country.

Slaby and D'Arco.—The Allgemeine Elektricitäts Gesellschaft exhibits a system designed by Slaby and D'Arco in Berlin, and this deserves a little consideration, as the inventors have replaced the usual vertical insulated wire, so well known in connection with wireless systems in this country, by a vertical cage, the upper end of which is connected to earth.*

Poulsen Microphonograph.—Perhaps the invention of the greatest scientific interest is the Poulsen microphonograph, by which a telephone conversation can be permanently recorded on a steel wire and reproduced at any time.†

At present this invention is in the early stage of scientific discovery. It may be used by a telephone subscriber to record an important communication, and it promises to afford means of obtaining a telephone repeater, a problem which has been before the electrical world for the last 12 years, and which so far has not been solved in a satisfactory manner. A telephone repeater would increase the range of telephonic speech and decrease the cost of long lines. The president of one of the American telephone companies some time ago offered publicly a reward of $1,000,000 for a thoroughly satisfactory telephone repeater, but the money has not yet been earned.

Telephone Hirmondo.—Amongst the miscellaneous exhibits is one by the "Telephone Hirmondo" which provides news and musical transmission alone, but without telephone intercommunication, in the city of Buda-Pesth. Technically there is very little information to be derived from the exhibit, which is rather statistical than technical, but I was rather surprised to learn that the number of subscribers to the system had increased from 3,750 on January 1st, 1895, to 7,560 on January 1st, 1900, all the wires being overhead. In practice items of news are spoken into the main transmitting telephones at the central station every quarter of an hour, and such items are repeated until a fresh batch is started. So far it is an electrical substitute for an evening paper combined with a theatrophone installation.

I came across a novelty in telephone administration. In the capital of Mexico they have absolutely free trade in telephone exchanges, which may be erected by any body or company with the sole proviso that there must be intercommunication between the systems. There are eight separate companies at work, with an aggregate of 4,000 subscribers, the average rate of payment being 12½ francs per subscriber per month.

At the meeting of the Electrical Congress various papers were read which have been or will be published. A committee was likewise formed to considered the question of units, and some radical proposals were brought forward, which would have involved an entire change in the existing methods of electrical measurement. The whole subject was very keenly debated, and anything in the nature of a radical alteration was outvoted. The committee restricted itself to giving definite names to two of the existing units, which up to the present had been known as the "C.G.S. unit of magnetic field," and the "C.G.S. unit of magnetic flux." These propositions were then submitted to a meeting of the official delegates, and were practically carried unanimously. A further proposition was submitted to the delegates to the effect that electrical energy was property, and that its theft should be punishable by law. This was also carried. In Great Britain existing Acts of Parliament define electrical energy and provide against its theft, but in certain countries it has been argued that electricity cannot be weighed, and that no punishment can be inflicted for stealing it, hence the above resolution.

INSTITUTION OF ELECTRICAL ENGINEERS (MANCHESTER SECTION).

RELATIVE ADVANTAGES OF DIRECT CURRENT AND THREE-PHASE DISTRIBUTION FOR SMALL INSTALLATIONS.

By Hardman A. Earle, M.I.C.E., M.I.E.E.

(*Read Tuesday, November 27th*, 1900.)

When accepting an invitation to read a paper before this Institution, I was for some time in doubt as to what subject I should choose; none was particularly uppermost in my mind as one upon which I wished to discourse, but I came to a decision while travelling abroad; the question covered by the title of my paper being brought most prominently before me, owing to the competition and

* See Electrical Review, *August 31st* 1900.
† See Electrical Review, *October 12th*, 1900.

different statements I met with, with regard to the relative advantages of three-phase and direct current machinery for small and medium sized installations. Owing to this it occurred to me that a comparison between the two systems would be of interest and likely to give rise during its discussion to points which would be a guide for the future. Competition is not always, especially in some countries, carried on on strictly commercial lines, and I have experienced instances where a competing firm, finding it could not secure an order for direct current machinery, has offered polyphase machinery as an alternative, singing its praises at great length, setting forth advantages without number, and naturally ignoring the other side of the question. This is not as it should be, but with inexperienced purchasers, with no one to guide them, it is at times successful.

I have found the title I first adopted for my paper somewhat too limited in its scope, and have briefly considered questions which relate to the distribution from sub-stations, as well as that of the choice of machinery and distribution for small installations.

The type of machinery and the system to be adopted for supply and distribution are, in the case of large plants, most carefully considered; simplicity of design, first cost, and subsequently economy, being among the most important of the many factors.

In the case of small installations, however, such as are put down to supply light and power for mills and factories, the question is not infrequently decided irrespective of theoretical considerations.

The purchaser in England is very usually in the hands of the consulting engineer, but in countries where this commodity does not exist, he is often guided by the persuasive power of the seller, and sometimes by fashion. For the lowest price may mean but little as regards cheapness when there is no specification. There are many ways of preparing a low tender; and the omission of something in one which is included in another, the adoption of different voltages, various groupings of lamps and motors, different speeds for generators and motors, may give one system an apparent advantage over another which it does not in reality possess.

Many firms have, up to the present, given their chief attention to direct current work, and this has met the wants of the smaller installations as well as those of the greater portion of the large central stations. Single-phase supply at high voltage, with distribution from transformer stations, has competed keenly with direct current, but lamps of higher voltage, together with three-wire distribution, have given the latter a long lease of life, and enabled it to be employed for large areas without undue loss or a prohibitive cost of copper.

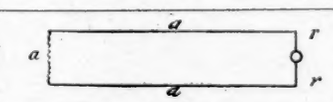
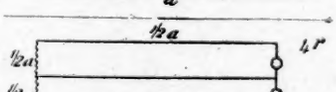
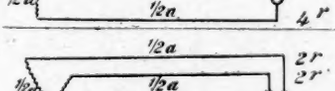
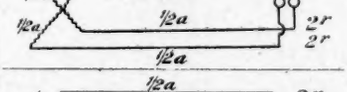
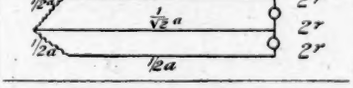
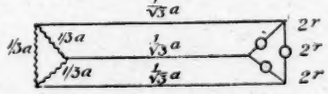
We have seen 50-volt, and subsequently 100-volt lamps in regular use for large installations, but now 200 up to 230-volt lamps are quite the accepted standard, and this higher pressure has so largely reduced the first cost of copper, that in many stations where the use of alternating currents was formerly warranted, direct current machinery is being put down, and even in some instances the alternating current machinery is being taken out. Running and driven balancers, together with feeder boosters, are required as auxiliary machines for direct current three-wire distribution, from sub-stations dealing with large powers, and feeding over a considerable area; but it is more than probable that in the future 400-volt lamps will be available, which, with a two-wire distribution, would render the two first-named machines unnecessary, and eliminate the cost of the centre wire. As polyphase and monophase machinery lives on the price of copper, it can be fairly assumed that every saving in this respect will take away their livelihood and reduce their utility. Where lighting constitutes the largest proportion of the load, the copper required is proportional to the watts per candle taken by the incandescent lamps, any reduction, therefore, in this respect, is of great importance; lamps are, I understand, shortly to be put on the market, consuming 2 watts per candle, or even less, and every advance in this direction is, I again hold, to the advantage of direct current, and will enable it to cover a wider field, for who will use high voltages and transform down, if they can use low with equal economy, or include complications when they may be omitted? All auxiliary machinery and apparatus has only one object, and that is to reduce the price of the mains, or, as I have seen it stated, the vain endeavour to cheat Ohm's law out of its due tribute of copper.

There are some who blindly champion alternating and polyphase systems, call commutators excrescences, and quote experiments, which claim to show that polyphase machines weigh a mere fraction of direct-current machines. A statement in Herr von Dobrowolsky's remarks in the discussion on a paper read by Herr Görges in 1892, was quoted in the first edition of a book, and has again appeared in the second edition, namely, that a certain multipolar continuous current machine gave 11,000 watts, but that when a three-phase armature was run in the same fields, it gave an output of 33,000 watts. I doubt this test being one which one could consider upon a commercial basis. On turning, however, to the paper in question, I find that Herr von Dobrowolsky also said: An alternating current machine is so totally different in its construction to a direct-current machine, that such comparisons cannot be fairly made, and that it is equivalent to saying that a spoon has an efficiency of 100 per cent. when used for soup, but only one of 50 per cent. when used for cutting.

Notwithstanding all this the polyphase system is at the present time the most satisfactory solution of long-distance transmission, and will be utilised more and more to transmit large powers into the centre of towns, and to cope with the many difficulties which present themselves, but the chief point I desire to raise is, whether the distribution from the sub-stations should be by polyphase or direct current, and whether for smaller installations one system offers such advantages over the other as to warrant a preference being given.

Notwithstanding the existence of several eminent advocates of single-phase machinery I do not propose to consider it, nor have I had to deal with it in connection with the competition I have experienced, especially abroad.

With regard to the two remaining rival systems the commutator

		Equal Pressure on the Lamps.	Equal Power Transmitted.		Equal Loss in the Line.			
System.	Diagram of system. ~~~ represents dynamo windings. —o— „ 200-volt lamp.	Virtual volts between any two wires = V.	Maximum voltage.	Current in outers for equal total power = $200a$.	Resistance of each outer for equal total loss = $2a^2r$.	Weight of each outer. — No current in centre wire.	Weight of the centre wire taken as ½ of each outer.	Total copper for equal lamp pressure power and loss.	Weight of copper cc. = 100.
Continuous current two wires		200	200	a	r	1	—	2	100
Continuous current three wires		400	400	½a	4r	¼	1/16	9/16	28
Two-phase four wires		200	$V\sqrt{2}$ 283	½a	2r	½	—	2	100
Two-phase three wires		200√2 283	$V\sqrt{2}$ 400	½a	2r	½	½ same as outer	1½	75
Three-phase mesh		200	$V\sqrt{2}$ 283	$\frac{1}{\sqrt{3}}a$	2r	½	—	1½	75
Three-phase star		200√3 346	$V\sqrt{2}$ 490	⅓a	6r	⅛	1/24	13/24	27

method has been adopted by the Post Office for its London tele-

† See ELECTRICAL REVIEW, *October 12th*, 1900.

seems to be the red rag of polyphase exponents, but any trouble that has been experienced on this behalf is merely a passing nightmare, and has only occurred with machines of large power running at high speeds, in connection with which considerable experience is required and very high class workmanship demanded in order to enable carbon brushes to maintain good contact on a surface running sometimes as high as 40 miles an hour; this difficulty has been experienced by most of us, but is being rapidly overcome, and in a short period it will be a thing of the past. It is, however, much to be desired that the high engine speeds which have been saddled upon us for plants of 1,000 horse and upwards, may in the future be reduced some 20 per cent.

With reference to the comparative weights of direct current and polyphase generators, we may take as a good example of the latter one of the 32-pole three-phase generators, built for the Central London Railway, which has an output on full load of 850 KW. at 94 revolutions; this machine has a weight of 37 tons, or with exciter, say 39 tons. As an example of a large direct current traction and lighting generator, we may take one of a number of 10-pole machines, now being built at Salford Ironworks, having an output of 900 KW. with fixed lead, and running at 95 revolutions per minute. This machine has a weight of 45 tons, or correcting for the increased output, it equals 42 tons; this machine could, however, have been built lighter as a shunt generator, with the compound windings omitted, and with the smaller range of voltage then necessary, the magnets would have been lighter, and probably with advantage more in number; the weight would then have been practically identical with the polyphase generator, with which it has been compared.

With regard to the weights and prices of still larger generators, I have compared a 1,400 KW. $\times \cos \phi$, polyphase generator running at 93 revolutions, with a direct current one of the same output, and for the same speed, the former with exciter would weigh approximately some 64 tons, and the direct current generator approximately the same. Comparing the prices of the above machines, the polyphase has the advantage and is approximately some 12 per cent. cheaper to build, this being chiefly due to the cost of the commutator on the direct current machine.

There is, however, one point which cannot be passed by unnoticed and that is the small safety clause attached to the output of the polyphase machine, namely, cosine ϕ, what is this? Why it means that on an inductive load this apparent 12 per cent. advantage is wiped out, and may even, and very probably will, put the boot on the other foot, but more of this later on.

With regard to smaller sizes of 200 to 400 KW., I do not find that there is much difference, in fact, the figures I have tend to show that the advantage is on the side of direct current, but I will not press this point.

Respecting the weights of the two types of motors, the polyphase type with squirrel cage rotor is considerably lighter, but the large motors of 50 to 100 H.P., with wound rotors, weigh about the same.

Comparing the price at which the smaller sizes are sold, the polyphase have an advantage of about 5 per cent.; but figures I have carefully examined for motors from 10 to 100 H.P. with wound rotors show a good average of 10 per cent. in favour of continuous current, when compared with polyphase motors imported into this country, and the cost of importation does not amount to 10 per cent.

Considering next the cost or weight of mains, the advantage is on the side of three-wire direct current distribution, as may be seen from the table given on page 887.

In the above table it is assumed that the various systems are for incandescent lighting as well as for power, and that the voltage is limited by the lamps, the circuits being so arranged that each lamp can be switched on singly.

As regards the voltage, column 1 gives the virtual volts between any two wires when lamps of the same pressure, namely, 200 volts, are employed on each system, but this figure may certainly be taken exception to in the case of the alternating systems, for it must not be forgotten that their maximum voltage is the $\sqrt{2}$ times their working voltage, or 1·41 times as great. And this cannot be lost sight of when taking into consideration the questions of insulation and risk from shocks. I have, accordingly, given in column 2 the maximum voltage between any two mains on this basis.

There is also another point to be borne in mind in connection with the mains for polyphase systems which contain many motors, and that is for equal loss they must be increased in section at least 10 per cent. above that given in the table, and required for continuous current systems, in order to allow for the loss due to wattless currents, and this figure may have to be still further increased to 20 per cent. or even more should many of the motors be put down to deal with very variable loads; in fact, the section of the mains in the table must be increased in the inverse ratio of the power factor of the system, taking into consideration both motors and lamps.

In the comparison, a third or common wire has been included, where necessary, to fulfil the condition of individual control, but the systems are assumed to be in balance, *i.e.*, there is no loss in the centre wire, which has been taken in all cases as 25 per cent. of the weight of an outer.

It is seen that continuous current three-wire systems are only beaten by one, namely, in the case of the three-phase star with common return, but then the saving by having only three wires instead of four to fix and insulate, would cancel this small difference, not to mention the better regulation which can be obtained with continuous current machinery.

With regard to this small difference of one, the three-phase star has, moreover, no right to it, for it is entirely eliminated, and the tables are turned, by what I have said respecting the loss due to wattless currents when motors are used; and the three-wire direct current system is then found to be at least 10 per cent. the best of all, as regards the weight of copper.

From the way I have drawn the diagrams of the three-phase star circuits, it can readily be seen why, when lamps are used, the fourth, or common wire is necessary to maintain proper regulation of voltage on the lamps, for without it the system would be comparable to a continuous current two-wire system with three lamps in series.

Turning next to the question of running motors upon the circuits, the points to be considered are—

(1) Starting torque.
(2) Regulation of speed.
(3) Constancy of speed.
(4) Efficiency.

Polyphase motors are essentially constant speed machines, and the speed of the smaller sizes is high, the arrangement of the winding is limited, and in this respect they do not so readily lend themselves as continuous current motors do, to windings by which any desired speed can be obtained; various ingenious methods have been adopted to meet the requirements, which are more or less satisfactory, but there is still considerable room for further development.

1. *Starting Torque.*—A continuous current motor, even when shunt wound, exerts its full torque, with a small increase of current over the full load current, and is capable of satisfactorily dealing with any work for which it may be employed; small three-phase motors with squirrel cage rotors, starting with full torque, require a momentary rush of current approximately equal to 2½ times the full load current. This is an undesirable feature, and to obviate it motors of larger powers are started up with a resistance in the rotor circuit; this minimises but does not remove this defect.

This behaviour would prevent a three-phase power installation being arranged so that all motors may start up with the generator. With respect to this, I arranged a power installation of 850 E.H.P. in a large spinning and weaving mill abroad, in which are included some ten compound wound continuous current motors, placed long distances apart, and ranging from 220 to 30 H.P.; in this installation all the motors can start up simultaneously with the generator, on practically full load, the starting current required being not more than some 50 per cent. in excess of the full working current.

In cases where the running torque is constant, but where a great starting torque is required, series wound continuous current motors offer the best solution.

I have one case especially in my mind, in connection with a polyphase installation in a cotton mill, where a large number of motors of 8 B.H.P., with squirrel cage rotors, were put down, each to run a line shaft driving 24 narrow looms; in this case trouble was experienced in starting up, belts coming off, or the motors, especially on Monday morning, when everything was stiff, refusing to start at all. Larger motors were in some instances put in, and in others fast and loose pulleys were added; a 7 H.P. direct current motor would have done the same work, and have given better results.

One method of increasing the torque of polyphase motors, on starting, is to increase the voltage on the stator by means of a booster transformer.

Another method is to alter the connections of the stator windings from star to mesh; this increasing the pressure in the ratio of 1·73 : 1. Another arrangement is to change the connections of the stator coils from series to two sets in parallel.

The requisite starting torque can, however, be obtained from a direct current motor, whether shunt or series wound, without any of these devices.

2. *Speed Regulation.*—The regulation of speed, either of continuous current or of polyphase induction motors, is effected by somewhat similar means.

The speed of an ordinary shunt-motor can be varied in three ways, either by inserting a resistance in the armature circuit, by altering the voltage of supply, or by varying the strength of the fields.

Like shunt or series direct current motors, polyphase motors, except the smallest sizes, require a resistance to be inserted in the rotor or revolving windings to keep the starting current within bounds, merely by the use of such a resistance any desired variation of speed can be obtained with either type; with this method of regulation, however, the input remains practically constant, and it is therefore too wasteful to be adopted where a high average efficiency is imperative throughout the whole range of speeds.

A direct current motor running on a three-wire system with two voltages available, combined with regulation of the field, can be made to yield a very high mean efficiency, equalling 83 per cent. for the whole of the working range—that is, for some 66 per cent. of the speeds—and an average of 75 per cent. throughout the whole range. Weakening the field by introducing resistance into the stator circuit of a polyphase motor increases the slip and the motor runs slower, but as the field supplies the rotor current in the same manner as the primary of a transformer supplies the secondary, the torque falls off very rapidly.

By doubling the number of poles in the stator winding the speed can be halved; this necessitates, however, an inconvenient number of windings, increases the complications of the switch, &c., and is rather impracticable.

Considering the various devices as a whole, one cannot but be drawn to the conclusion that the direct current motor on a three-wire system, with two voltages available, or on a two-wire system with double wound armature, together with the provision for some field regulation, is the simplest and most desirable, for it gives all variations of speed most economically, and it can be easily arranged so that there is no jump whatever between one speed and another. Three or four instances have come to my notice where power has been transmitted to a works from a considerable distance by polyphase current, but in connection with which motor-generators have been added to supply direct current to motors requiring to be operated through a large range of speed at a high mean efficiency.

3. *Constancy of Speed under Varying Loads.*—In this respect a shunt wound continuous current motor acknowledges no superiority to the polyphase, the slip on the latter increases with the load, but shunt wound motors are available which can maintain constant speed from no load to full load.

For tramway work a polyphase motor will maintain a more constant speed when climbing hills than a series wound continuous current motor, but as this is at the expense of current, a high speed on the level and a slower speed on hills seems more to be desired, and likely to reduce the maximum current demanded from the station.

4. *Efficiency.*—I have compared the efficiencies of direct current motors which have been most accurately tested, with figures which I consider are fairly representative of what can be obtained with polyphase, and give the comparisons below.

	3½	6	10	25	50	100 B.H.P.
Direct current	82%	85%	86%	91%	92%	92%
Polyphase	75%	80%	84%	88%	90%	91%

This shows a large superiority for direct current motors of small power, and a small advantage on the larger sizes.

The power factors of polyphase motors, as far as any published figures go, as well as those which are obtained from various makers, vary more widely than seems at all necessary, and in order to obtain a fair average, I dotted all the power factors I could get upon a sheet of paper, and then drew a curve through the lot, and I give you below the readings which resulted from this curve.

Power factor for polyphase motors on full load:—

B.H.P.	5	10	15	25	50	100
P.F.	·76	·79	·81	·83	·86	·88

With regard to the above, it is needless to remark that the power factor of continuous current motors is unity.

Having considered how the various operations are effected for changing either the speed or torque or both, lets us consider the conditions under which motors have to work; these may be divided under four heads and stated as follows:—

(1.) Constant speed with constant torque.
(2.) „ „ variable „
(3.) Variable „ constant „
(4.) „ „ variable „

Constant Speed with Constant Torque.—This condition is one which exists, when motors are used to drive lengths of shafting, from which again are driven a considerable number of small machines, such as are found in a cotton mill, or a large machine shop; in this instance the load is fairly constant, possibly not varying more than some 10 per cent.; it is in such cases that a polyphase motor is at its best, and endeavours to rival the shunt wound direct current motor, which, however, is just as good for the purpose, or probably a little better.

Constant Speed with Variable Torque.—This second condition occurs in cases where large portions of the load are being frequently thrown on and off; the shunt wound motor is all that can be desired as regards speed on such work, and the current taken is in fair proportion to the load. The polyphase motor is also satisfactory as regards speed, but the current is high on the lighter loads; a considerable percentage is certainly wattless current, but it adds up the C^2R losses, and at the same time decreases the capability of the generator for useful work, and this is a point which must be borne in mind when comparing a polyphase generator with a direct current one.

We have seen how a power factor less than unity for the motors, necessitates an increase in the size of the mains, and this acts in a similar manner upon the generator. If the current were in phase with the E.M.F.—that is, if the power factor were 1, in place of averaging, say, ·85—the polyphase generator could do 17½ per cent. more work than it would be able to do under the latter condition. But, again, with many motors working on a system, a power factor of ·85 cannot always be relied upon, and one of ·75 or even lower may have to be reckoned with. We see from this that the first cost of an installation may be considerably increased by this consideration, and, besides this, the wattless currents exercise a very bad effect on the regulation of a three-phase machine, very much more so than if the currents were in phase, necessitating very much heavier windings on the magnets to deal with a low power factor than a high one.

Variable Speed with Constant Torque.—The third condition is met with very frequently, for instance, when driving callenders, paper-making machinery, and in pumping, &c. To meet it with polyphase motors the regulating switches are more complicated, and to effect many changes of speed the groupings of the winding become many in number and efficiency is sacrificed; in this respect the continuous-current motor is more easily managed and will yield a higher mean efficiency.

Variable Speed with Variable Torque.—The fourth condition is especially present when driving calico printing machinery, an eight-colour machine for instance may be utilised for printing any desired number of the eight colours; the torque increases practically in direct proportion to the number of rollers in use, the speed of printing the goods at the same time varies in accordance with the number of colours being printed, and with the class of work the machine is doing.

For this class of work a very even turning moment is necessary; one must be able to run up to any desired speed without jumps or jerks, and the contemplation of a three-phase motor arranged for high efficiency at all speeds and to comply with the requisite conditions, is not a taking one.

I have heard the point raised that for factories where there is much inflammable dust about, a chance spark from the commutator might set the place on fire, but perfectly satisfactory entirely enclosed direct current motors are at work, not considering the thousands on tramcars, but also in factories of all descriptions; fire-proof gauze covers are also employed for motors, these do not exclude all ventilation, and render the motor quite reliable even where spirit vapours are present.

The facility for the use of batteries on direct-current systems is one which must receive careful consideration. These are continually improving in quality, give excellent results in the hands of those that understand them, and offer great advantages, both as a stand-by, and as regulators; they can, therefore, frequently be utilised to assist direct-current supply, and at times to effect considerable economy, whereas a three-phase battery has yet to be invented.

Polyphase motors appear specially suitable for long lines of railway where considerable distances are travelled without a stop at a uniform rate of speed, and where crossing points which would complicate the conductors do not exist, for beyond a comparatively limited distance high voltage must be used, and then, whichever system is employed, transforming apparatus is necessary; in such instances polyphase supply, with polyphase motors on the train, would not call for rotating transformers, stationary transformers along the line being the simplest and cheapest arrangement.

Such a system, is, however, unsuitable for use in towns, with frequent stops and a very variable rate of speed; besides this, I am sure that it would create a great commotion among the inhabitants of a town not 100 miles away, if it were proposed to erect two trolley wires in place of the one, which to some already appears distasteful. Judging from what some of the larger firms on the Continent are doing with respect to polyphase machinery, I understand that, although they have given it the very greatest attention, they find that the volume of their direct current work exceeds that of the polyphase.

I have endeavoured to consider the chief points which should guide us in the choice of a system for use for the smaller installations.

In cases where lighting alone is required, the first cost of polyphase or direct current would appear to be very similar; the simplicity of the latter system both as regards the wiring and the regulation of the voltage, to my mind, gives direct current the preference.

Where a number of motors are on the circuit for whatever purpose they may be required, and whether the system includes lighting or not, I consider that direct current shows a very decided advantage except in a few very special cases; moreover, the use of batteries is all but excluded with polyphase systems, even for a night load, and this is frequently of considerable importance. I have, doubtless, to some minds, left unsaid many things I ought to have said, and to others said many things I ought not to have said, but this may be more an advantage than otherwise, for it will admit of those shortcomings being criticised during the discussion, and may enable me to fill the gaps and correct my errors.

ELECTRIC FURNACES.*

The employment of the electric furnace has made rapid advance within the last few years, and we find to-day a large number of forms in practical use. It will be of interest, therefore, to study the different types which they represent and the progress made in their construction.

The forms in use to-day have been derived, for the most part, from the form of crucible of Siemens and Hutington or from the Moissan furnace.

Moissan Furnace.—This furnace is characterised by the employment of the electric arc as a source of heat only and not as an electro-chemical agent. By its means temperatures are attained in excess of those from any types previously used. The highest temperatures attainable by furnaces other than the electric type are limited to about 1,800°; the blowpipe with illuminating gas and oxygen gives 2,000°; with the Moissan furnace temperatures certainly exceeding 3,000° are possible.

In this apparatus the arc plays between two horizontal carbons extending into a narrow chamber hollowed out of a block of quicklime. A cover of the same material closes the furnace, and reflects the heat from the arc upon the material to be treated, which is placed beneath the carbons. The calorific action of the current is thus clearly separated from its electrolytic action. The arrangement also prevents any impurities of the electrodes from intermingling with the substances melted.

As a result of the feeble conducting power of the material used, a thickness of the dome of only 30 millimetres is sufficient to allow a fusing of its lower face, with the production of the Drummond light, while the exterior face of the dome remains cool enough to handle.

Siemens Furnace.—This furnace is designed along other lines. The first Siemens furnaces were intended for fusing metals, and consisted each of a crucible of refractory material, with double walls of an insulating envelope, and receiving the electric current at its base. A vertical electrode, placed above the crucible, served as the second conductor. The material introduced in the crucible took the place of the intermediate conductor, and the electric arc played between the electrode and the material itself. The automatic regu-

* Abstract of a paper read before the Paris Electrical Congress of August 18th—25th, 1900, by Mr. Keller (*Western Electrician*).

tables are turned, by what I have said respecting the loss due to wattless currents when motors are used; and the three-wire direct

operated through a large range of speed at a high mean efficiency.

lation of the arc is obtained by a shunt solenoid, placed in the circuit and producing a displacement of the electrode.

Industrial Furnaces.

Cowles Furnace.—In 1885 appeared the Cowles furnace, with which were made the first applications of electricity to the reduction of oxides.

In this apparatus one end of a chamber of refractory material is made of a conducting substance and constitutes one pole. The other extremity of the chamber is closed by a graphite crucible, forming the other pole.

In 1887 the Cowles brothers took out a new patent on an electric furnace in which the charge was introduced in a continuous manner.

Héroult Furnace.—The Héroult furnace, applied first to the reduction of alumina by copper, is based upon the same principle as thatiof Cowles. The copper is introduced into the furnace in the form of granules. The current melts the metal between the two electrodes. The alumina is then poured in, and one obtains an alloy of aluminium and copper.

Froges Furnace.—The factories of Froges and of Neuhausen have employed the Héroult furnace in the manufacture of aluminium. On the appearance of carbide of calcium the same furnaces served for the manufacture of this substance.

The special furnace designed for this latter purpose, and which is called by the name of Froges, is composed of a vertical electrode capable of an up-and-down movement, in a chamber whose base is carbon, and which is mounted upon rollers. This chamber constitutes the second electrode. The walls are double and of an insulating material. The carbide is taken out to cool through an opening in the lower part of the furnace, and when the operation is finished the movable furnace is removed and exchanged for another.

Modern Applications.

The appearance of carbide of calcium was a signal for the designing of electric furnaces of great efficiency and of continual operation. These forms may be classified as: First, those based upon the Moissan and Siemens furnaces, called arc furnaces; second, those based upon the Héroult type, called resistance furnaces; third, those modelled after the first Cowles furnace, called superficial resistance furnaces or incandescence furnaces.

Arc furnaces may be classified as follows: Single-arc furnaces with two movable electrodes: single-arc furnaces with one movable electrode; furnaces with several arcs.

Single-arc Furnaces with Two Movable Electrodes.—The two electrodes are the more often placed in an inclined position and capable of being thrust into a chamber of refractory material. The material to be treated is placed about the arc, being introduced at the top of the furnace.

To this type belong the Patin furnace, that of the Deutsche Gold und Silberscheide Anstalt, for the production of calcium carbide, and the Street furnace for the production of graphite.

Single-Arc Furnaces with One Movable Electrode.—The movable electrode is ordinarily placed vertically; the fixed electrode is placed horizontally or inclined, and is built up of an assemblage of carbons called the "sole."

The material is introduced at the upper part of the furnace, and the arc plays first between the movable electrode and the sole, then between the fixed electrode and the molten material. The tension employed in this type of furnace varies from 50 to 60 volts.

To this category belong the electric furnaces of the Société des Carbures Métallique, shown at the Exposition, and the systems of Siemens & Halske, Schuckert, &c.

Furnaces with Multiple Arcs.—These are only variations of the two preceding types. They are employed to distribute the calorific action of the arc over greater surfaces, and not merely at the point of emission of the arc.

To this type belong the Gin and Leleux furnace, those of Bertolus or Memmo, Nicolaï, Bovy, &c. The first of these has been employed for the manufacture of calcium carbide and of phosphorus; it contains four pairs of carbons, four arcs in a single chamber, and its sole has a helicoidal movement below the arcs.

The Bertolus furnace, employed in the factories of Bellegarde, uses a three-phase electric current and three arcs, by means of three movable carbons inclined and placed above a common sole connected or not connected to the dynamo.

The Nicolaï furnaces are composed of a metallic crown, covered with carbons and forming one pole; the other pole consists of several electrodes placed circularly and given a movement of rotation above the fixed metallic crown, upon which the material to be treated is spread.

In all these furnaces the temperature seems to vary with the current intensity. The potential employed being almost constant for a given application, it follows that in powerful furnaces the temperature is too high in the arc itself. The employment of multiple arcs only imperfectly remedies the chief fault of the use of the electric arc, which is that it produces at a certain point a great volatilisation of the material and sometimes a dissociation of the substances obtained.

The movable electric arc behaves badly at best; its resistance is made endlessly variable, and its temperature is either too low or too high. The manufacture of calcium carbide, especially, is practically impossible with this type of furnaces.

It should be remarked that, the electric arc being inductive, its employment as a resistance on an alternating circuit provokes a lag of current which represents a considerable drop of potential.

Resistance Furnaces.—These furnaces are built as the preceding, ut arranged o work only at low tension. The electric work is represented by Joule's formula, and the temperature obtained, for a given power, is a function of the cross-section of the electrodes.

In furnaces based upon this principle the fusion is quiet; the gas resulting is not blown violently out of the furnace, as is the case with the electric arc.

With these furnaces, in the manufacture of calcium carbide, an electromotive force of only 20 to 25 volts is required.

In the furnaces of Gin and Leleux the movable electrode serving to regulate the tension is built up of carbons of different conductivities, and is sometimes 800 millimetres on a side.

Furnaces with Superficial Resistance.—In this type the electrodes do not of themselves permit the passage of current. It is necessary at the start that the electrodes be united by some conductor, like powdered carbon. This conductor is then carried to a high incandescence by the current and forms a bed of fusion upon which the material to be reduced is placed. This type of furnace allows us to utilise in one chamber a greater power than any other, for this power, for a given current, varies with the displacement of the electrodes—a displacement which is easy to regulate.

To this class of furnaces belong the Cowles furnace and others more recently designed, using two groups of electrodes.

Direct-current machines were originally the only source of energy used for electric furnaces, but now we utilise single-phase and polyphase alternating generators. The first electric furnaces using direct currents, and in which electrolytic action took place, have been designated as electrolytic furnaces, in distinction from those known as electrothermic furnaces.

Alternating Current Furnaces.

The employment of alternating currents for furnaces has been greatly extended, because it ensures a better mechanical working, the alternating current machines suffering less than others from the sudden variations of resistance which may be produced in the electric furnace. Moreover, the electrolytic action of continuous currents, often very objectionable, is obviated, and the two electrodes are equally consumed, by the use of alternating currents.

With an alternating single-phase current the furnaces can be placed in series or in parallel, like any ordinary resistances. But since, when put in series, the stopping of one furnace will throw the whole battery out of action, we rarely place more than two furnaces in series on the same circuit. Arc furnaces perform better in quantity than singly, as sudden variations are then avoided. Incandescence furnaces, with their great regularity of working, may, on the other hand, be used advantageously when connected in series.

Furnaces with Polyphase Current.—The Bertolus furnace was the first of this type, using, as we have seen, three electrodes connected to the three terminals of the generator, with a common sole. The two-phase current has been utilised in a similar manner. But generally the different phases of polyphase currents are used separately in furnaces operating as single-phase furnaces. The employment of polyphase currents allows a considerable economy in copper in the feed circuits.

Electrodes.

The difficulty of obtaining electrodes of sufficient dimensions and convenient form for a long time limited the size and power of furnaces. The consumption of these electrodes constitute an important element in the economic production of calcium carbide. The carbons of high conductivity making up the electrodes, are burned in contact with the air, because of the excessive temperatures, and it is now sought to shield these from the air, and cool them by a circulation of water about the parts exposed. In the latest forms of Gin and Leleux cold air is substituted.

Voltage and Current Strength.

Low tension currents of 8,000 to 10,000 amperes are frequently employed. As it is impracticable with these heavy currents to use circuit breakers, the movable electrode of the furnace serves for this purpose.

The manufacture of carbide of calcium requires potentials of 50 to 60 volts. The fusion of bauxite for the manufacture of artificial corundum requires 50 volts; that of iron ores requires only 20 volts, on account of the high conductivity of the vapours given off.

In superficial resistance furnaces, because of the arrangement of the electrodes, which allows the introduction of a great quantity of material to be fused, the potentials may be carried as high as 80 to 100 volts.

Conclusion.

According to recent estimates, the power utilised in electric furnaces to-day represents a total of nearly 230,000 H.P., of which the manufacture of carbide of calcium consumes 185,000; that of aluminium, 27,000; that of copper, 11,000; and that of carborundum, 2,000 H.P. In France alone over 60,000 H.P. is consumed in the calcium carbide industry.

The joint manufacture of phosphorus and calcium carbide in the electric furnace has been attempted during the last year; and, very recently, that of vanadium and of ferrochrome, in the works of Savoie.

Great advance has been made of late in the mode of construction of electric furnaces. Thus the output from apparatus for the manufacture of calcium carbide, which was only 3 kilogrammes per kilowatt per 24 hours in 1897, is to-day, in the Gin and Leleux furnace, 6·2 kilogrammes. This represents a thermal efficiency for this furnace of about 75 per cent.

OUR LEGAL QUERY COLUMN.

Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

No. 33.

"E. O. W." writes:—"A reply to the following inquiry would oblige. Within what time from the appointment of a liquidator ought the shareholders of a limited liability company, which is being wound up, to be furnished with accounts, and if they are not then forthcoming, what is the remedy?

*** It is provided by Section 142 of the Companies Act, 1862 that as soon as the affairs of a company are fully wound up, the liquidators shall make up an account showing the manner in which such winding-up has been conducted, and the property of the company disposed of, and thereupon they shall call a general meeting of the company for the purpose of having the account laid before them, and hearing any explanation that may be given by the liquidators. It is also provided in the Companies Act that if the winding-up is not concluded within one year after its commencement, the liquidator must, within 30 days from the expiration of such 12 months, and at subsequent intervals of six months, send to the Registrar of Joint Stock Companies a sworn statement with respect to the proceedings in and position of the liquidation. This statement contains the items of receipts and payments, and gives particulars of the total liabilities, the value of outstanding assets, and the probable duration of the winding up, with reasons for any delay in its termination. Any default in sending this statement renders the liquidator liable to a penalty of £50 a day. As to the remedy of any shareholder, it is competent for any shareholder to apply to the Court under Section 138. The Court may then determine any question arising as to the conduct of the liquidator.

SYSTEMS OF CURRENT DISTRIBUTION ON TRAMWAYS.

(*Continued from page* 724.)

American experience of efficiencies is quoted as follows for different systems with the motors on full load:—

	Per cent.
Large low voltage triphase generator	95·5
Large high voltage triphase generator	95
Large up-step transformers	97·5
High potential continuous generators	92
High potential continuous motors	90
Step-down transformers	97
Low tension synchronous motors	95
High tension synchronous motors	94
125-volt continuous generators	92
Rotary converters	93·5

With a line efficiency of 90 per cent. the overall efficiency for continuous currents will be 69·3 per cent., and for triphase currents as follows (see p. 724, paragraph *o*):—

System (α), 71 per cent.
„ (β), 72·6 „
„ (γ), 74·9 „
„ (δ), 76·2 „
„ (ϵ), 77·7 „

While only approximate these figures give an idea sufficient to show that system (ϵ) with high tension triphase currents, step-down transformers, and rotary converters will give the best efficiency, and for this and the other reasons detailed this is the system chosen for Marseilles.

The Falk Joint.

The Falk joint was the next subject before the Congress in a paper by Mr. Fischer Dick, who had tried the joint in Berlin and preferred it after an experience with other joints. He concludes that the Falk joint has freed engineers from much thought in connection with line maintenance and the effects of the wheels. By the Falk system no doubt is felt that great savings may be effected.

There are said to be 40,000 Falk joints in Chicago; they have also been used in Lyons, Havre, Marseilles, Paris, Rouen and Nice, and 8,000 have been made in Berlin. The cost per joint at Havre is given for all expenses, and including carriage and 4 f. royalty, at 20 f. 30 c., while at Lyons the cost was 20 f. 10 c., and in the United States it has been done for 10 f. This did not cover all expenses, however. The cost of fish-plates and labour in connection therewith is, of course, entirely saved by using the Falk joint. The number of failures is small. The maximum was 5 per cent. in St. Paul and Minneapolis in macadam and paving, and *nil* in asphalte; it was 1 per cent. in Milwaukee; 0·25 in Chicago, and but 0·08 in Paris.

All joints are cast in Berlin, but in Minneapolis an ordinary joint is placed about every 300 metres. In Berlin all joints are welded. The Compagnie Francaise de Tramways has welded some rails all the length of the line, and with Vignoles rails at each length of 250 m. places an ordinary joint to ease the effects of expansion and contraction. It is particularly noticeable how good is the hold of rails in asphalte, only one case of failure having occurred in Berlin, and none in St. Paul, though many went in macadam.

The conductivity of rails thus welded is practically equal to that of the rail itself. There need be no further bonding unless as a measure of prudence to guard against possible breakage. Conduction as well as strength is entirely a question of the proper cleaning of the rail ends before casting. Contraction in Berlin amounts to 35 or 50 mm. per 100 m. Breakages usually occur soon after casting and others are caused by frost at a later period. The Falk joint is a means of adding years of life to old ways of which the joints have become bad, while new rails thus jointed will have an incomparably longer life than ordinary rails. The joint stops the noise which occurs when a car runs over the rail, though, of course, it cannot do so if already the rail ends are bad by long usage. Thus in Berlin there is still noise at welded joints which had had two years' previous wear. Traction is, of course, reduced by the cast joint, as also is maintenance. The casting does not heat the rail head to a point that causes permanent softening. A disadvantage of the Falk system is admitted to be the inconvenience of casting a few joints only at a time, because the cupola must be made to melt more metal than can be utilised. It is remarked that the new Alumino-Thermique system of Goldschmidt may be tried on such cases. It seems to us that if this new system will do what it appears likely to do, it will quite replace the Falk system either for Falk joints or for actually welding the rails into truly continuous lengths requiring no bonding. Welding is an undoubted improvement, for somehow the fished joint never seems to be successfully made, though we do not believe there is a real necessity for this. Our experience of the kind of concrete commonly used for tramway track is that the stuff is often little better than stiffened mud, into which rail ends very quickly hammer hollows. A really well-fished rail joint with a stiff under plate on sound concrete would last much longer than the joints as usually made.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1900.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

20,311. "Improvements in electrical cushions for tables and the like." O. T. Banks. Dated November 12th.

20,357. "An improved self-contained portable electric lamp." J. McHardy. Dated November 12th.

20,362. "Improvements in renewing the filaments of electric incandescent lamps." C. Howard. Dated November 12th. (Complete.)

20,383. "Improvements relating to alternating current induction motors." B. G. Lamme. (Date applied for under Patents, &c., Act, 1883, Section 103, April 14th, 1900, being date of application in United States.) Dated November 12th.

20,384. "Improvements relating to systems of electrical distribution." B. J. Lamme. (Date applied for under Patents, &c., Act, 1883, Section 103, April 14th, 1900, being date of application in United States.) Dated November 12th.

20,389. "Improvements in electric fire alarms." O. Freymann. Dated November 13th.

20,466. "Improved electric apparatus for exploding mines." Eversheds and Vignoles, Limited, and S. Eversheds. Dated November 13th.

20,471. "Improvements in or relating to connectors for electric wires and the like." J. R. Jones. Dated November 13th. (Complete.)

20,498. "Improvements in and appertaining to distributing boards for electrical circuits." A. M. Taylor. Dated November 14th.

20,507. "Improvements in sparking plugs for electrically-fired internal combustion engines." R. F. Hall. Dated November 14th. (Complete.)

20,522. "Improvements in high-potential line switches for electric currents." The British Thomson-Houston Company, Limited. (E. M. Hewlett, United States.) Dated November 14th. (Complete.)

20,540. "Improved device for indicating the movements of a mariner's compass." C. D. Abel. (Siemens & Halske Aktien-Gesellschaft, Germany.) Dated November 14th.

20,558. "Improvements in and relating to combined telephone and electric bell circuits." The Berliner Telephone Manufacturing Company. (J. Berliner, Germany.) Dated November 14th. (Complete.)

20,573. "Improvements in electric controllers." W. H. Harfield. Dated November 14th.

20,576. "Improvements in apparatus for signalling by wireless telegraphy." J. A. Fleming and Marconi's Wireless Telegraph Company, Limited. Dated November 14th.

20,590. "Certain improvements in carriers for portable electric cables in combination with holder for lamps." R. Smith. Dated November 15th.

20,631. "Improvements in automatic electric carriages and appliances for the transport of light goods or traffic." H. Dubs and L. Laffitte. Dated November 15th.

20,707. "Electric exercising machine." M. B. Ryan. Dated November 16th.

20,757. "Improvements in apparatus for generating pulsative constant electric currents." E. Van Haanen. Dated November 17th.

20,758. "Improvements in machines for generating constant electric currents." E. Van Haanen. Dated November 17th.

20,761. "A new method of constructing electrical cells of the Leclanché type." D. F. B. Cotes. Dated November 17th.

20,764. "Improvements in shade fittings for incandescent electric lamps." A. A. Guest. Dated November 17th.

20,765. "Improvements in or relating to electric lampholders." C. W. Kemp. Dated November 17th.

20,778. "Improvements in electric arc lamps." J. A. Heany. Dated November 17th. (Complete.)

20,779. "Improvements in electric arc lamps." J. A. Heany. Dated November 17th. (Complete.)

20,797. "Improvements relating to sound-magnifying appliances for telephones, phonographs, and the like." O. RIEGER. Dated November 17th.

20,800. "Manufacture of a primer for producing ignition by electricity." R. KANDLER. Dated November 17th.

20,808. "Improvements in or connected with electrical burglar alarms." J. H. PENNINGTON and V. YATES. Dated November 17th. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 323, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1898.

23,534. "Improvements in governors for air compressors driven by electric motors." The British Thomson-Houston Company, Limited. (S. H. Libby and W. P. Potter.) Dated November 8th 1898. Relates to pneumatic governors for air compressors driven by electric motors, and consists of means for controlling the electric motor automatically by a switch arrangement actuated by mechanism sensitive to variations in air pressure. The switch contacts mounted for oscillatory movement on iron fingers, but insulated from the shaft, make or break contact with the fixed brushes according as the motor requires accelarating or retarding. The forked arm to which is hinged the piece is rigidly mounted on the shaft and through the hinged piece imparts the motion of the piston to the shaft. The arm and spring act on the piece and tend to keep the piece in that position in which the arm is stopped by the projection on the base. The main piston and cylinder are for actuating the switch, and are related to the auxiliary piston and spring-pressed plunger. A rod having a collar and screwed at one end into a nut to which a spring is attached, presses against the piston. The pin acted on by the springs serves as a valve between the auxiliary cylinder and the main cylinder. On the right side of the casting is mounted a strainer to prevent dirt from entering the governor from the pressure pipe connecting the governor with the air receiving tank. Above the switch mechanism the coil of the blow-out magnet is placed, receives current from a part of the contacts on the switch mechanism, and energises the magnet for interrupting the arcs formed when the circuit is interrupted between the stationary brushes and the movable contacts. For preference, a direct connected series motor, which may be belted, should be used. 10 claims.

23,556. "Improvements in submarine cable telegraphs." W. L. Wise. (A. C. Crehore and G. O. Squier.) Dated November 8th 1898. Relates to improvements in the class of telegraphs described in Specification No. 6,787, A.D. 1897, in which sinusoidal or other similar currents are employed. The message is sent by means of a perforated strip in which the two rows of single perforations are so formed as to allow a half phase current to pass. 4 claims.

23,624. "Improvements in or relating to the utilization of Hertzian and similar radiations and apparatus therefor." L. H. Walter. Dated November 9th, 1898. Relates to the utilisation of Hertzian or like radiations, the transmitter and receiver being so arranged that the latter is not operated by unauthorised radiations. The transmitter emits radiations in a pre-arranged order, and the receiver is only operated by such radiations, a "safety" appliance being connected with the receiver, which is set back to zero on receipt of false signals. The induction coil with spark gap is excited by a battery when an electro-magnet is energised by a current sent to it from the codal transmitting device operated by the key. On depressing the key contact is made and the magnet is energised, attracting its armature and withdrawing a stop from a recess in a disc, which is then free to rotate under the action of a spring. The disc carries a second disc fitted with contacts arranged in any desired number and order. These contacts touch a contact and hence signals are sent in the desired order. In the receiver is the coherer adapted to complete the circuit around an electro-magnet. A disc carrying contacts similarly disposed to the contacts on the second disc and caused to rotate synchronously with it by means of a spring when it is released by the first signal, a stop being withdrawn from a recess. The contacts are insulated from the disc. When the impulses are received in the true codal order, the electro-magnetic device is operated, and the contact brought against the contact to close the local circuit. Should an impulse other than a codal one arrive at the transmitter, the electro-magnet is energised through the circuit and the pawls disengaged from the ratchet-wheels. The contact is then returned to zero by the spring. 9 claims.

23,659. "Improvements in and relating to the electrical propulsion of tramway cars, railway carriages and the like by a road contact system." D. Robertson, jun. Dated November 10th, 1898. Relates to electric railways and tramways on a road-contact system with electro-magnetic switches. Current from the main conductor is supplied to the slider on the vehicle through one set of road contacts and switches which are actuated by a current of low potential from a second conductor through a second row of road contacts and a slider. These contacts are alternately connected to the conductor and to the actuating coil on the switch. This coil pulls down a tubular plunger and thereby raises the mercury to complete the circuit between the projecting terminals connected to the supply conductor and the road contact studs as shown in section. The plunger is protected by insulation, and may be solid instead of tubular; other means than the subsidiary conductor may supply current for actuating the switches. 5 claims.

23,706. "Improvements in the manufacture of dynamo brushes." J. C. Laissing. Dated November 10th, 1898. The brushes of dynamo-electric machines are made out of fine wire gauze of suitable material, such as phosphor or sodium bronze, which is cut into strips diagonally with the wires, and flattened out by passing the strips between rolls or the like. 1 claim.

23,750. "Improvements in electro-dynamic relays for use on telephone and telegraph lines." S. G. Brown. Dated November 11th, 1898. Relays for telegraph and telephone working are constructed as generators in which the inductive effect is neutralised by dividing the magnet poles into pairs, and so crossing these that pairs of reversed poles are obtained and no current generated in the armature. The pole-pieces are further provided with a series of coils connected to line and earth; any line current disturbs the magnetic neutrality, and the armature currents produced actuate the local relay circuit. The provisional specification describes arrangements for using a unipolar generator, the low potential currents obtained being passed through a transformer. 3 claims.

23,820. "Improvements in apparatus for measuring the phase difference of alternating currents and idle currents." Dr. J. Tuma and M. R. Kaldegg. Dated November 11th, 1898. Relates to an apparatus for indicating difference in phase of two alternating currents of equal frequency by the angle through which a pointer deflects, is constructed in sections. It is applicable also for measuring wattless current supply through it and frequency. It consists of stationary coils set at right angles to each other, and preferably wound on spherical supports to produce uniform internal magnetic fields in which another coil turns. The movable coil is hung from a pivoted pointer, movable over a dial, and is of fine wire connected to mercury cups or wire spirals with a two-pole two-way switch, by which it can be connected either to the ends of a low resistance, inserted in a conductor carrying a main current, or to conductors for a second current. The main current also passes through the stationary coil and through the primary of an air-core transformer. The stationary coil has two windings, one of thick wire connected to the ends of the main resistance and the other of thin wire connected with the secondary of the transformer through an adjustable resistance by means of the magnetic fields of the stationary coils are made equal in intensity and 90° different in phase. The windings of the other stationary coil are both normally connected by a spring-actuated switch. When the movable coil is connected with the main resistance, and the variable resistance is properly adjusted, opening and closing of the switch produces no deflections. The amount of the adjustable resistance is a measure of the frequency of the currents. When the movable coil is supplied with another current from the conductors, the deflection of the needle measures the phase difference of the two currents. If the movable coil is connected between two mains conveying the main current and is turned back to zero by a torsion spring and pointer, the angle of turning of the pointer measures the idle current flowing in the circuit. 3 claims.

23,821. "Improvements in and relating to coin-freed telephones." A. E. Gillespie and J. Gillespie. Dated November 11th, 1898. Telephones. In private instruments it is arranged that one payment shall enable a subscriber to use the instrument a definite number of times. A number of double-wound electro-magnets bearing armatures upon sliding frames are wired up in parallel in the ringing-up circuit and in the telephone circuit respectively, between pairs of bar terminals. In one circuit, the parallels of the second and following electro-magnets include the first and following armatures, and in each of these parallels there is a key mounted in a bridge which is part of the armature frame. In the coin action and coin-discharging mechanism, the coin weighs down the first key to complete the circuit, and this key, in moving with the armature frame, is tilted by posts so as to make the coin roll off and drop to the second key. With the reversal of magnetisation by a current in the telephone circuit, the first armature is detached by a spring and re-set, while, when the subscriber has spoken off, he rings off, thus causing the second armature to be attracted and to drop the coin to the third lever, leaving the armature, however, attracted until demagnetisation is effected from the exchange. 7 claims.

23,827. "Improvements in the art of electric dyeing and in apparatus therefor." C. D. Barton. Dated November 12th, 1898. Relates to electric dyeing silk, wool, cotton, and other fibrous substances, furs, leather, and other materials, whether raw or manufactured, such as hats and buttons of ivory, bone, horn, &c. The articles or materials are treated in a vat, preferably of porcelain, in which are placed two electrodes preferably of carbon or carbonaceous material and lead. Guide rollers are arranged to immerse the material which is passed through by means of two feed rollers. To produce a double immersion, guide rollers may be arranged over the centre of the vat. The vat contains a solution of sodium chloride, sulphuric acid, the dye and water, which may be heated by ordinary means or by the electric current, a rheostat being arranged to regulate the current. For dyeing brown or black, the dye is heated before immersing the fabric, &c. Insulating screens may be placed between the electrodes, or the vessel may be conducting and formed one electrode. 8 claims.

23,858. "Improvements in electric measuring instruments." The British Thomson-Houston Company, Limited. (E. Thomson.) Dated November 14th 1898. Current and energy meters. Two independent measuring instruments are attached to one base, and have needles moving over adjacent scales, so that an observer may make readings of both simultaneously. They may measure volts, amperes, or watts, and may be of any construction. An instrument measuring volts and amperes is described. Needles carried by two shafts move over scale plates, the graduated parts of which are visible through openings in a casing. Each shaft carries a copper disc provided with coils. These move between the ends of two pairs of bar magnets, supported astatically near the shafts by clamps, which also carry the shaft bearings and insulated plates. The coils are connected electrically and controlled by flat spiral springs attached to the shaft and to pins on the insulating plate. The coils of the voltmeter are connected in series with high resistances wound on bobbins attached to the base. Those of the amperemeter are connected to the ends of a resistance-carrying the current to be measured. 9 claims.

27,636. "Improvements in electric arc lamps." A. W. Arter. Dated December 31st, 1898. Solenoid regulating mechanism is modified from that described in Specification No. 13,304, A.D. 1898. The carbon holders are connected by cords or racks directly with opposite sides of a large wheel which is supported by a frame pivoted and an inclined spring. The pivot is carried by brackets within a large slot in the wheel. The wheel may be weighted to compensate for the varying difference in weight of the carbons when continuous current is used. The spring may be replaced by a weight and cord acting on an eccentric pulley. A cord is attached to and wound on a part of the wheel of small diameter, and is connected directly or by a lever with the core of a series or differential solenoid on the side of the wheel axle opposite the heavier upper carbon holder. The spring is of such strength that the solenoid core lowers the wheel and frame bodily about the pivot to strike the arc, the pull of the cord on the small part then balancing the pull of the upper holder on the other side of the wheel. 3 claims.

1899.

3,311. "Improvements in or relating to arc lamps." W. P. Thompson. (C. J. Tearing, United States.) Dated February 14th, 1899. Consists in making the arc enclosure of a transparent part. The heat radiating surface of which shall be as small as possible, and of a heat-retaining part which is composed of a non-heat-conducting material for the purpose of obtaining a high temperature. The non-conducting part completely encloses the upper carbon and part of the operating mechanism. 21 claims.

3,591. "Improvements in telephone systems." L. M. Ericsson. Dated February 17th, 1899. Consists of a reversing apparatus for effecting the connection of the main line leading to a central exchange with any one of the subscriber's circuits attached to the switch apparatus, which reversing apparatus is provided with a wire coil connection with the main line and of electro-magnets, by the aid of which the subscriber's circuits are connected with the main line, and the coils of which are respectively coupled in a corresponding subscriber's circuit. The arrangement of the reversing apparatus consists of a fixed permanent magnet, between the pole shoes of which is located a wire coil carried by a rotatable frame and coupled in the main line from the central exchange, each subscriber's magnet being connected to a permanent magnet, one pole of which is in contact with a piece of iron serving as an armature, and acted on by a constant force produced by a spring or the like. 5 claims.

8,044. "Improvements in metallic conduit for electric wires." E. T. Greenfield. Dated April 17th, 1899. (Date applied for under Section 103, Act 1883, December 12th, 1898, being date of first application in a foreign country.) Consists in a metallic conduit vented radially in all directions throughout its length, so as to permit free circulation of the atmosphere and prevent gases produced by short circuit from collecting and causing an explosion. 2 claims.

12,184. "Dynamo-electric generators." J. N. Smith and W. A. Johnston. Dated June 10th, 1899. Consists essentially, first, in the multiple method of connections, and second, in making the machine of the two circular field-coil type. The armature is provided with a plurality of projecting teeth or poles and a plurality of coils on each pole connected to one another in series. 5 claims.

12,183. "Improvements in cut-outs for electrical purposes." T. Taylor. Dated June 12th, 1899. Relates to and an improvement on Specification 28,347, of 1896. Through the material of the insulating or non-conducting base of the cut-out a pair of open-ended passages are formed through which the fuse wire passes in proceeding from one terminal to the other for the purpose of lengthening the fuse without enlarging the cut-out. 2 claims.

13,431. "An improvement in brush-holders for electric machines." J. Burke. Dated June 26th, 1899. Consists of a ring or other suitable piece fixed on an insulated part connected to the holder proper by two or more pairs of links and an adjustable helical spring. 1 claim.

13,732. "Improvements in storage batteries." C. E. Lee. Dated July 3rd, 1899. Consists of a series of self-centred cylindrical like battery units, each consisting of a central positive element, with a surrounding approximate cylindrical negative element with a common containing cell having an electrolyte in which all the units are immersed and a series of conductors whereby all the positive and all the negative elements are connected to their respective central termini. 5 claims.

13,802. "Improvements in multi-rate electric meters." The British Thomson-Houston Co., Ltd. (E. Thomson and F. P. Cox, United States.) Dated July 4th, 1899. Relates to electric meters and consists of the adaption of any well-known form of meter to a more equitable method of registration than ordinary, by connecting to a ordinary watt or other meter resistances, or other rate varying means over the contacts of which a switch arm is moved by a cam driven by clockwork mechanism. 11 claims.